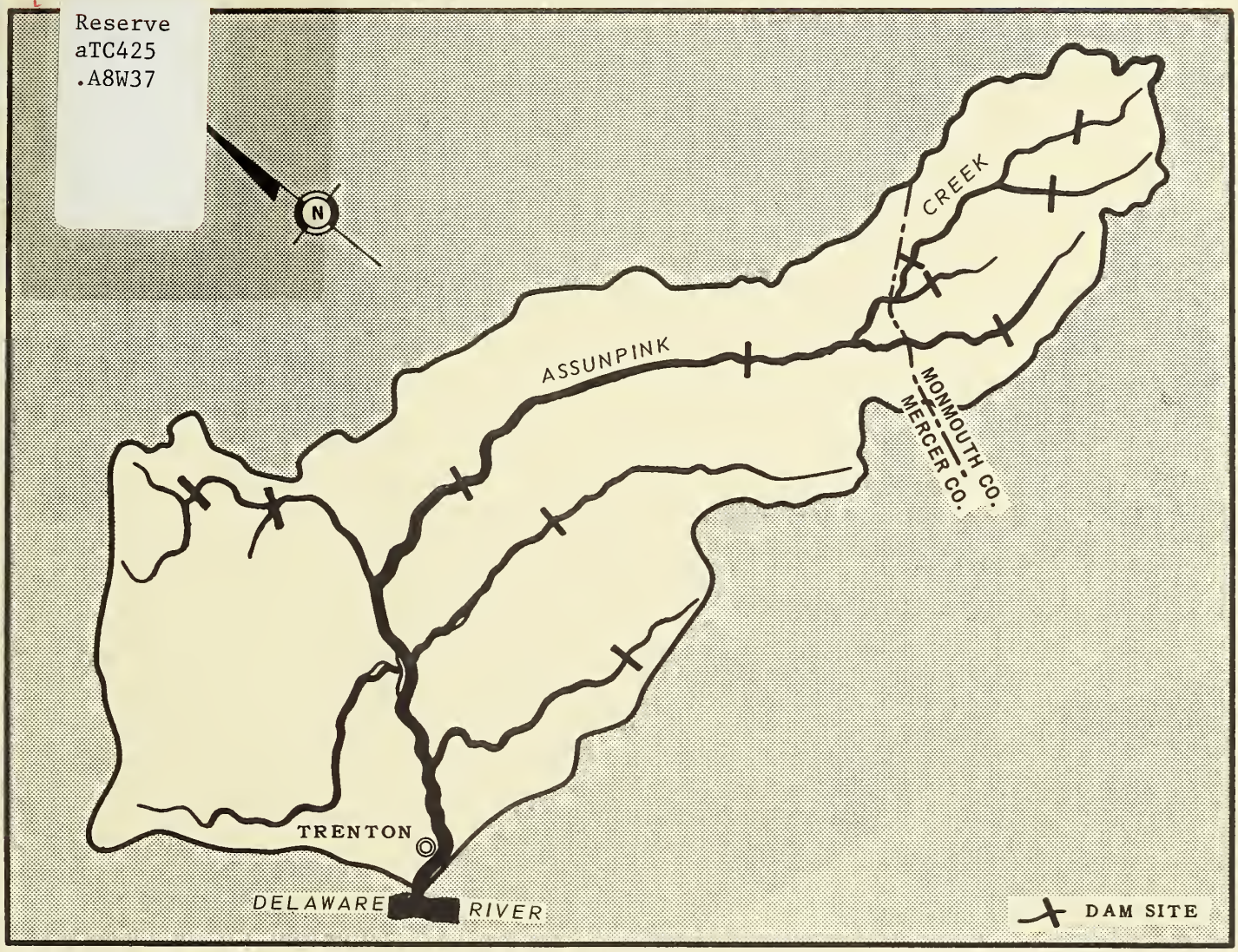


ASSUNPINK CREEK WATERSHED WORK PLAN

MERCER AND MONMOUTH COUNTIES, NEW JERSEY

WATERSHED WORK PLAN

ASSUNPINK CREEK WATERSHED

Mercer and Monmouth Counties

Prepared under the authority of the
Watershed Protection and Flood Prevention Act

(P. L. 566, 83d Cong., 68 Stat. 666 as amended)

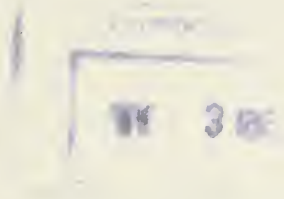
Prepared by:

Mercer County Soil Conservation District
Freehold Soil Conservation District
Mercer County
Monmouth County
New Jersey Department of Conservation and Economic Development
Hamilton Township
Upper Freehold Township

Assisted by:

United States Department of Agriculture
Soil Conservation Service
Forest Service

July 1964



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SUMMARY OF PLAN

The Assunpink Creek Watershed is located in the center of New Jersey. Most of Trenton, on the Delaware River, is within the watershed. It drains an area of 58,300 acres, 48,600 of which lie in Mercer County and 9,700 in Monmouth County.

The sponsoring local organizations are the Mercer County Soil Conservation District, the Freehold Soil Conservation District, Mercer County, Monmouth County, the New Jersey Department of Conservation and Economic Development, and Hamilton Township in Mercer County.

The storm of September 1882 resulted in the greatest known runoff in the history of the watershed. One life was lost in this flood. The biggest storm in 40 years of U.S.G.S. records occurred in September 1938, in which 8.77 inches of rainfall fell in 72 hours. It is estimated that this storm was of a magnitude that might occur once in 60 years. Since 1938 the channels have been restricted by floodplain encroachment, so that if the same intensity storm occurred today, direct damages of over $3,000,000 would result to industrial and residential property.

Other watershed problems include inadequate channels, which affect 557 acres of agricultural land, and a great need for recreation facilities in a rapidly growing area.

A comprehensive plan for reduction of damages and development of water resources in the Assunpink Creek Watershed has been developed by the sponsors, assisted by the U. S. Soil Conservation Service, the U. S. Forest Service and State agencies. State agencies participating in development of the work plan include the New Jersey Division of Fish and Game, the New Jersey Bureau of Forestry, and the New Jersey Bureau of Recreation, all in the Department of Conservation and Economic Development; and the State Soil Conservation Committee. Other Federal agencies consulted were the U. S. Geological Survey, the U. S. Fish and Wildlife Service, the Agricultural Stabilization and Conservation Service, the U. S. Army Corps of Engineers, and the Bureau of Outdoor Recreation.

In addition to conservation land treatment measures on agricultural land, this plan provides for 5 floodwater retarding structures, 5 multipurpose floodwater retarding-fish and wildlife structures, one multipurpose floodwater retarding-recreation structure (and basic recreational facilities) and 11.8 miles of stream channel improvement.

The measures provided for in this work plan are scheduled to be carried out over a period of 10 years. The estimated installation cost is $7,569,114, of which $4,824,766 will be paid from Public Law 566 funds and the remaining $2,744,348 from other funds.

Land Treatment Measures

The estimated cost for land treatment measures is $307,280 of which $256,004 will be borne by other funds. The Public Law 566 share, estimated at $51,276 is to be used entirely for accelerated technical assistance, of which $42,676 will be provided by the Soil Conservation Service and $8,600 by the U. S. Forest Service.

Structural Measures

Ten floodwater retarding or multipurpose structures will control about 52 percent of the drainage area on the main stem damage reach. They will have storage capacity for 8,145 acre feet of floodwater and 1,957 acre feet for recreation and fish and wildlife. The permanent pools will total 606 acres.

One floodwater retarding structure (Site 8) on Pond Run, will control about 28 percent of the drainage area above the Pond Run damage reach. It will have storage capacity for 504 acre feet of floodwater. This will be supplemented by 2.4 miles of stream channel improvement.

Remaining structural measures consist of 9.4 miles of stream channel improvement on three tributaries in the upper reaches of the watershed. These will provide benefits to agricultural land.

Damages and Benefits

The present average annual floodwater damage along Assunpink Creek and Pond Run is estimated at $216,191. With the project installed damages from the 100-year frequency storm will be virtually eliminated. The lower one mile of Assunpink Creek is subject to floodwater damages from the Delaware River. No benefits were claimed for this reach, since the project will have no effect on these damages.

Stream channel improvements on New Sharon Branch, Bridegroom Run and Hancock Creek will provide a 5 year level of flood protection and adequate outlets for tile drainage. There are 557 acres of agricultural land devoted to truck crops, potatoes, small grain and hay involved. These benefits are estimated at $39,307 annually, including secondary benefits.

Recreation benefits are estimated at $393,000 annually. These include $3,000 incidental recreation benefits from floodwater retarding Site 8 and $390,000 of primary recreation benefits from the recreational development on Site 20.

Fish and wildlife benefits from multipurpose Sites 4, 5, 6, 18 and 19 are estimated at $22,965 annually.

The total average annual benefits are estimated at $691,054, of which $4,692 are from land treatment measures and $686,362 from structural measures.

The ratio of average annual benefits from structural measures to

average annual costs is $686,362 to $302,120, or 2.3 to 1.0.

Financial Provisions

The installation cost of structural measures is estimated to be $7,261,834. Of this, $4,773,490 will be paid by Public Law 566 funds and $2,488,344 by other funds. The installation cost includes $2,528,986 for land, easements and rights-of-way, of which the Public Law 566 share is $778,550 and other share is $1,750,436. It also includes $18,269 for administration of contracts, all of which will be paid from other than Public Law 566 funds.

Operation and Maintenance

Land treatment measures will be operated and maintained by landowners and operators under agreements with the Mercer County and Freehold Soil Conservation Districts.

Technical assistance for the operation and maintenance of forestry measures will be provided by the New Jersey Bureau of Forestry in cooperation with the U. S. Forest Service through the Cooperative Forest Management Program.

The overall operation and maintenance cost for structural measures is estimated at $71,272 annually, of which $66,263 are for recreation and fish and wildlife measures.

The New Jersey Department of Conservation and Economic Development will operate and maintain Sites 4, 5, 6, 18 and 19, including fish and wildlife facilities. The estimated cost is $8,303 a year.

The Mercer County Soil Conservation District will maintain Sites 7 and 7A, estimated at $600 annually.

Hamilton Township will operate and maintain Site 8 and Pond Run stream channel improvement. The estimated annual cost is $985.

Monmouth County will maintain Site 15 and the Monmouth County part of stream channel improvement on New Sharon Branch, estimated to cost $1,136.

Mercer County will operate and maintain Sites 20 and 21, including recreation facilities on Site 20, and stream channel improvements on Bridegroom Run, Hancock Creek and the Mercer County portion of New Sharon Branch. The estimated cost is $60,248.

DESCRIPTION OF THE WATERSHED

Physical Data

The Assunpink Creek Watershed covers 58,300 acres, of which 48,600 are in Mercer County and 9,700 in Monmouth County.

From headwaters in Monmouth County, the creek flows westward for

16 miles, then in a southerly direction for 5 miles, passing through the heart of Trenton and into the Delaware River. Major tributaries are westerly flowing Miry Run and Pond Run and easterly flowing Shipetauken Creek and Shabakunk Creek. They all join the Assunpink within a span of 4 miles immediately upstream from the Trenton city line.

Except for the upper 2 miles of Assunpink Creek which drops about 57 feet per mile, the gradient is relatively flat, averaging 5 feet per mile. Both Miry Run and Pond Run also have relatively flat gradients. Shipetauken and Shabakunk Creeks are considerably faster flowing, the average gradients being about 25 feet per mile. Elevations range from 320 feet above mean sea level in the eastern extremity of the watershed to 20 feet at the outlet of Assunpink Creek.

Numerous swamps and marshes exist along the major streams.

The average annual precipitation is 41 inches, the heaviest occurring from March to September. The mean annual temperature is 53 degrees, ranging from an average of 33 degrees in January to 76 degrees in July. The frost free period generally extends from early April to early November.

Geologic Data

The watershed of the Assunpink Creek straddles the boundary between the sandy soils of the Coastal Plain and the silty soils of the Piedmont. The following table shows the succession of geologic formations along a section extending from Lawrenceville, through a point between Edinburg and Windsor.

Physiograph Province	Age	Formation	Lithology
Piedmont	Triassic	Lockatong	massive, hard argillite
		Stockton	arkosic sandstone
Coastal Plain	Cretaceous	Magothy & Raritan	interstratified clays & fine sands
		Merchantville	black sandy clay
		Woodbury	black & gray clays
		Englishtown	yellow sands
		Marshalltown	black sandy clay, micaceous
		Mount Laurel & Wenona	coarse and fine sands
		Navesink	dark highly glauconitic sandy clays
		Red Bank	coarse rusty sand
	Tertiary	Hornerstown	dark, highly glauconitic sandy clays
		Vincentown	fine to medium sand
		Kirkwood sand	
		Beacon Hill	quartz, chert, sandstone, ironstone gravels and sands
	Quaternary	Pennsauken	sandy and gravelly silts and silty sands
		Cape May	sands and gravels
	Recent	Alluvium	recent stream deposited mineral and organic silts

The rock layers of the Piedmont section dip at about 20 degrees toward the northwest. The loose, sandy, silty and clayey deposits of the Cretaceous and Tertiary portions of the Coastal Plain dip toward the sea at about 20 feet to the mile. The Quaternary deposit of the Pennsauken formation forms a mantle, 25 to 50 feet thick, over the older formations at elevations between 50 and 100 feet. The Cape May formation occurs as low terraces and valley fills extending up the main streams and tributaries to about 50 feet in elevation.

Recent streams have re-excavated shallow channels in the lower portion of the Coastal Plain, but have refilled them with a thin layer, 4-10 feet thick, of mineral and organic silts overlying thin layers of alluvial sands.

The main area of the silty sands and gravels (Pennsauken) occurs as a wide northeast-southwest trending band about 10 miles wide between Lawrenceville and Sharon.

Minor areas of gneiss and schist outcrop near Trenton and plunge under the Coastal Plain toward Lawrence Station, helping establish local base levels for the main branch of the Assunpink and its westward flowing tributaries. In general these basement rocks dip toward the sea at a moderate angle.

A major fault line extends from the northern edge of Trenton northeastward towards Plainsboro.

Soils Data

The soils of the watershed, also, are divided into Coastal Plain and Piedmont sections. The main soils of the Coastal Plain are the excellent agricultural sandy loams and loams of the Sassafras, Collington, Freehold and Matapeak series. Closely associated and related to these are other soils with drainage problems: Woodstown, Fallsington, Adelphia, and Shrewsbury. When properly drained they are productive and adapted to a wide variety of crops.

Droughty, infertile sands make up a considerable portion of the hilly section at the headwaters of the Assunpink. These are Lakeland, Navesink, and Lincroft soils. Iron cemented sandstone strata, blocks and slabs suitable for riprap are a feature of Navesink soil areas, notable because rock is so rare in the Coastal Plain. Deep (8-10 feet) organic soils (muck) are a feature of many stream bottom areas in the Monmouth County reaches of the streams. In the Mercer County Coastal Plain section, highly organic, silty alluvium averages only 4 feet thick over sands and gravels.

Large swampy areas of organic silt and silty clay exist in the old drainage trough near Lawrenceville.

In the Piedmont section the good, well drained, moderately permeable, agricultural soils are Lansdale, Ewingville and Lawrenceville. Associated slowly permeable, wet soils are Chalfont and Croton.

Although a great proportion of the Coastal Plain section is in cropland, considerable areas of wet and droughty soils are occupied by forest stands. In the Piedmont section only a small proportion is in cropland. Most of it is being subdivided for development at a rapid pace. This is also true of sections of the Coastal Plain near Trenton.

Economic Data

The 165,000 population in the Assunpink Creek Watershed is centered around Trenton and adjoining communities. The remainder of the watershed is rural in character. The rural population represents about 33 percent of the total.

Present land use in the watershed is tabulated below:

Land Use	Acres	Percent
Cropland	24,500	42
Grassland	7,000	12
Forest Land	12,600	22
Other (Urban, Roads, Streams, etc.)	14,200	24
Total	58,300	100

The major farm enterprise is potatoes, in rotation with soybeans and grain. The best potato land in New Jersey is found here. Gross receipts of agricultural products in the watershed are estimated to exceed $12,000,000 annually. Farms in the watershed total about 390, of which 200 are under cooperative agreement with the Mercer County and Freehold Soil Conservation Districts, and 122 have basic conservation plans. The average farm has 110 acres and a value of $100,000. About 20 percent are tenant operated, the rest owner operated. Less than 1,000 acres in the watershed are in public ownership.

Forest land is subjected to high population pressures and should be under careful, multiple - use management to attain maximum utilization and benefits, including improved hydrologic conditions.

Of the 12,600 acres of forest land, about 3,800 occupy wet sites. Predominantly privately-owned, the forest stands are largely immature oak types of low commercial value. Quality sawlogs and pilings are in current demand and assistance is available to landowners through the Cooperative Programs of the New Jersey Bureau of Forestry and the U. S. Forest Service for the establishment, care and protection, and harvest of forest products.

Markets for farm produce are readily accessible. Trenton lies between the New York metropolitan area, 50 miles to the northeast, and Philadelphia, 30 miles to the southwest. The main line of the Pennsylvania Railroad between Philadelphia and New York City passes through Trenton. Other important arteries that cross the watershed are U. S. Routes 1 and 130 and the New Jersey Turnpike.

Trenton is a highly industrialized city. It is here that industry in the watershed is concentrated. Some of the industries are producing strategic defense materials.

WATERSHED PROBLEMS

Floodwater Damage

The principal floodwater damages occur in reach A, which extends from Whitehead Mill Pond on the main stem of Assunpink Creek, downstream to Oak Street, a distance of 1.3 miles. (See Project Map for location of damage reaches.) In reach A, covering an area of 73 acres, is a concentration of industries which are subject to floodwater

damage. They have a total value of approximately $27,000,000, and a weekly payroll of $350,000. Other damageable property includes about 25 residences, valued at $250,000, and 3 commercial establishments, having gross receipts of $290,000 per year.

A three day storm in September 1882, the greatest in the history of Trenton, resulted in damages amounting to many thousands of dollars and the loss of one life. The biggest storm in 40 years of U.S.G.S. records, estimated to be a 60 year frequency event, occurred in September 1938. This was a three day storm with associated precipitation amounting to 8.77 inches and direct runoff of 3.07 inches. The peak discharge was estimated to be only half that of the storm in 1882. Although damages from the 1938 storm were relatively low, the floodplain has since been encroached upon to the extent that if that same storm occurred today, damages would amount to over 3 million dollars. Other major storms include those of April 1924, and August 1955.

Damage caused by the frequent, low intensity storms is relatively small. These damages result primarily from the need for lifting industrial equipment above the flood stages and thus precluding its use.

It is the large storms in the 50-100 year frequency range that cause real concern. Damages from these high intensity storms include loss of inventory, physical damage to plants and equipment and losses caused by the need for shutting down operations. Several of the industries vulnerable to severe flood damages are in the business of manufacturing strategic defense materials.

The U. S. Weather Bureau, in cooperation with industries, has developed a storm warning system, whereby industries are alerted to possible flood stages.

Floodwater damages to residential, commercial and industrial property occur annually through an intensely developed area along Pond Run in Hamilton Township, shown as reach B on the map, extending from the Pennsylvania Railroad upstream to the vicinity of Kuser Road, a distance of about 2 miles. The channel in this reach is restricted. Damage on this tributary is caused primarily by the intense short duration storms. Recent storms causing damages in this reach include those of August 1955, July 1960, September 1960, September 1961, and March 1962.

Erosion and Sediment Damage

Streambank erosion and floodplain scour are minor problems. Normal sheet erosion averages less than 3 tons per acre per year. Much of the sediment that reaches the floodplain is deposited there. However, sediment contributes materially to urban property damage during major floods. Some channels on the main stem and tributaries have been silted to the extent of impeding drainage on adjacent agricultural land, but this has occurred over a long period of time.

Ewing, Lawrence and Hamilton Townships are rapidly becoming urbanized. Although the normal sediment yield is relatively low,

during the period of change from agricultural use to urban development it is markedly increased. Since much of the change to urbanization is anticipated to occur in the early stages of project life, and since the sediment yield is substantially reduced after the change is made, the overall effect of urbanization is a reduction in sediment over the life of the project.

Problems Relating to Water Management

Agricultural Water Management

A reach along New Sharon Branch and tributary channels, extending from Carsons Mills upstream to the abandoned Pennsylvania Railroad line is choked with debris, vegetation and sediment. The channels are inadequate to dispose of strom runoff and they are too shallow to provide outlets for tile drainage of agricultural land.

Similar conditions exist on Bridegroom Run, from Rt. 526 to the headwaters; and on Hancock Creek, which enters Assunpink Creek just downstream from the Monmouth-Mercer County line.

About 557 acres of agricultural land are thus adversely affected in inadequate channel capacity and depth. Farmers have been forced to revert to less intensive use of the land affected. Whereas once it was used for production of high quality truck and roughage crops, it is now used for low grade roughage. Where truck crops still are grown, both yields and quality have suffered. The soils are Shrewsbury, Woodstown and Fallsington, which are highly productive and adaptable to a wide variety of crops when adequately drained.

Recreation and Fish and Wildlife

New Jersey, with a population density of 806 persons per square mile, ranks second highest in the United States. Mercer County had 266,392 residents, or 1,168 per square mile, as of 1960. This represents an increase of about 16 percent since 1950. The future projected populations for Mercer County are 306,000 in 1970 and 380,000 in 1975.

Although there is an abundance of historic sites in the area, many of which are associated with the American Revolution, water related recreation facilities are inadequate.

Recreation areas owned and operated by Mercer County consist of the following:

Area	Facilities	Use
Valley Road Group Picnic Area	7 acres - picnic tables, and fireplaces, pavilion, softball, volley ball, water	Available to Mercer County groups of 50 or more - 12,000 users in 1963
Belle Mountain Family Picnic Area	15 acres - picnic tables, fireplaces, small lake for fishing	3,500 users in 1960
Herrontown Wood Arboretum	87 acres (in natural state) - trails for walking, water	10,400 users in 1963
Cedar Bliss Group Camping Area	7 acres (in natural state) natural camping area, water	Available to organized groups (Boy Scouts, Girl Scouts, etc.) - 4,200 users in 1963
John A. Roebling Memorial Park	200 acres (in natural state) - picnic tables with individual cooking units - spring fed lakes provide fishing	50,000 users in 1963
Belle Mountain Ski Run	15 acres - ski tow	14,000 users in 1963
Mountain View Golf Course	18 hole course	49,000 players in 1963

Washington Crossing State Park (operated by the State of New Jersey) is a 358 acre tract within Mercer County. Facilities include picnicking, and old McKonkey Ferry House is now maintained as a museum. This park accomodates 250,000 - 280,000 visitors a year.

Other state owned and operated recreation facilities within a 40 mile radius of the watershed are Lebanon State Forest, with its 22,216 acres and Island Beach Park, with 2,694 acres. The former is about 27 miles for the center of Mercer County. It provides for swimming, fishing, camping, hiking, hunting and picnicking. Island Beach State Park, about 40 miles distant, is located on the Atlantic Coast. It provides for saltwater swimming and fishing, picnicking and naturalist services.

In addition to state and county recreation facilities there are a few small municipal and private developments within Mercer County providing swimming, fishing and picnicking facilities.

Hunting and fishing rights are controlled by rod and gun clubs on 85 percent of the privately owned open land in Mercer County.

State and local officials are concerned about the recreational needs of the public in this heavily populated and rapidly growing area. They are concerned about the rapid dwindling of open spaces accessible to the public for hunting, fishing and other types of recreation.

The New Jersey Green Acres Program, passed by referendum in 1960, provided for $60,000,000 to be used in the state for acquisition of open space land to satisfy the present and future needs of the public.

PROJECTS OF OTHER AGENCIES

This project is within the Delaware River Basin. The water resources of the Basin are administered by an interstate - Federal compact commission, consisting of 5 persons - a Federal representative appointed by the President, and the State Governors of Pennsylvania, New York, New Jersey and Delaware. The commission is charged with adoption and operation of a single comprehensive plan for immediate and long-range development and uses of the water resources of the Delaware River Basin. Measures included in this plan will become a part of the Delaware River Basin Commission's comprehensive plan before installation begins.

The multipurpose use of floodwater retarding sites for recreation ties in perfectly with the New Jersey Green Acres Program, passed by referendum in 1960. The Department of Conservation and Economic Development, which administers the Green Acres Program, has adjusted its current plans for acquisition of open space to take advantage of the multiple use opportunities of this project.

BASIS FOR PROJECT FORMULATION

Industries along Assunpink Creek in the Trenton area are subject to devastating flood damages. A severe flood would be a great blow to the economy of this area. Many residents are dependent upon these industries for their livelihood. The danger of loss of life is real. Inasmuch as some of these industries produce strategic defense materials, the effects would reach beyond local importance. For these reasons, the sponsors desire complete protection against the 100 year frequency storm.

Increasing the capacity of the channel through reach A was determined to be impractical because of the intense development and the necessity for replacing numerous bridges. Furthermore, this would result in adverse effects downstream.

The installation of floodwater retarding structures is considered to be the most practical solution. Suitable sites were difficult to find because much of the area is highly developed. Out of over twenty sites investigated, ten of the best were chosen as satisfactory to provide the desired degree of protection.

Only one floodwater retarding site could be found above damage reach B on Pond Run. This site represents control of only 28 percent of the Pond Run drainage area. Hence, in order to achieve the 100 year

level of protection against floodwater damages in this reach, it is necessary to supplement the floodwater retarding structure with 2.4 miles of channel improvement.

Existing channels through agricultural areas on New Sharon Branch, Bridegroom Run and Hancock Creek are inadequate to dispose of storm runoff and are too shallow to provide outlets for existing and planned tile drains. Improved channels will carry at least 5 year frequency 24 hour flood volume and be sufficiently deep to serve as outlets for tile drains.

Due to the great need for recreation facilities in this area, including fishing and hunting, Sites 4, 5, 6, 18, 19, and 20 will be developed for recreation and fish and wildlife as well as floodwater retardation. Site 20 has been selected for the recreational development in which the Federal government will share in the cost of land, easements and rights-of-way, and in installation of minimum basic recreational facilities. This site is located in an area previously considered by Mercer County officials for expanding county recreation facilities. Sites 4, 5, 6, 18 and 19 will be developed for fishing and hunting.

A residential flood problem exists along the West Branch of Shabakunk Creek. The only feasible solution to this problem is a combination of stream channel improvement and construction of dikes and levees. Since the drainage area of this channel is entirely within an urban area, the solution of this problem is not within the intended authority of Public Law 566. No works of improvement for this tributary are included in this work plan.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The Mercer County Soil Conservation District and the Freehold Soil Conservation District will accelerate application of land treatment measures on agricultural land in order to keep soil losses to a minimum for protection of the reservoir and stream channel improvement structures, bring about more efficient farming operations, and to get the most benefit from improved outlets for farm drains.

Treatment of agricultural land is summarized in Table 1 by land use.

Cropland - Applicable conservation treatment measures include contour farming, crop residue use, conservation cropping systems, diversions, grass waterways, tile drains, tile systems structures, drainage mains or laterals, contour strip cropping and field strip cropping.

Forest land - Applicable conservation treatment includes tree planting and hydrologic cultural operations (thinning, weeding, improvement, salvage and harvest cuttings.)

Other functions of the Soil Conservation Districts include providing consultive type service for protection of non-agricultural lands, such as recreation areas and residential and industrial lands.

The Mercer County Soil Conservation District has long been concerned with the accelerated soil loss that accompanies the disturbing of vegetative cover preparatory to constructing shopping centers and other types of massive developments. The District will encourage developers and municipalities to use any practicable means available, both now and in the future, to reduce excessive soil loss and resulting sediment damages during periods of construction and immediately following construction. Examples of measures that might be considered are limitations on the amount of land disturbed ahead of building; seeding of cover crops immediately after completion of grading; establishing a vegetative cover on critical eroding areas and waterways; and construction of temporary sediment basins for use until the area is fully protected against erosion.

Structural Measures

Ten floodwater retarding structures control 52.3 percent of the drainage area affecting the damage reach on Assunpink Creek. Five of these are multipurpose flood prevention-fish and wildlife structures and one is a flood prevention-recreation structure.

Structure Sites 18 and 19 outlet into Site 4. Structure Sites 4, 5, and 15 all outlet into Site 6 which, in turn, drains into Site 20 on the main stem of Assunpink Creek. Structure Site 21, on Miry Run, is independent of any other structures. Structure Site 7A, and 7, just above it, are located on Shipetauken Creek.

The controlled drainage area affecting the Assunpink Creek damage reach in the Trenton area includes 36.9 percent above Site 20, 6.6 percent above Site 7A, and 8.8 percent above Site 21.

Structure Site 4 is located on the main stem of Assunpink Creek about one mile upstream from the Mercer-Monmouth County line. It is a multipurpose flood prevention-fish and wildlife site. The fish and wildlife pool will have a surface area of 120 acres. Sediment storage requirements for 100 year accumulation are 108 acre feet. The site controls a total of 9.3 square miles, including 3.0 square miles above Sites 18 and 19. This represents 10.4 percent of the critical drainage area above damage reach A. The dam will be 20 feet high and will consist of about 52,100 cubic yards of earth fill. It will have a two stage riser. The first stage will have a 5 csm release rate and the second stage will have a 25 csm release rate. The dam will store 3.65 inches of runoff below the emergency spillway crest. The emergency spillway will be 200 feet wide and will be cut in earth. The structure will have an estimated construction cost of $121,700.

Structure Site 5 is located on Horse Creek, a tributary of Assunpink Creek. The site is in Monmouth County, about one mile upstream from the Mercer County line. It is a multipurpose site for flood prevention and fish and wildlife. The fish and wildlife pool will have 126 surface acres. This site controls 1.6 square miles, or 1.8 percent of the critical drainage area. The dam will be about 14 feet high and will consist of about 13,400 cubic yards of earth fill. It will have a two stage riser. The first stage will have a 5 csm

release rate and the second stage a 25 csm release rate. Sediment storage requirements for 100 year evaluation are 31 acre feet. The total storage below the emergency spillway crest will be 4.18 inches of runoff. The emergency earth spillway is 50 feet wide. The structure has an estimated construction cost of $61,700.

Structure Site 6 is located on the main Assunpink Creek channel approximately 1,200 feet upstream from Route U. S. #130. It is a multipurpose flood prevention-fish and wildlife site. The fish and wildlife pool has a surface area of 82 acres. This dam controls a total of 22.0 square miles, including 9.3 square miles above Site 4, 1.6 square miles above Site 5, and 1.7 square miles above Site 15. This represents 24.7 percent of the critical drainage area. The earth fill will contain 53,400 cubic yards and will be about 23 feet high. The spillway will be a reinforced concrete drop structure with two stages. The first stage release rate is 5 csm and the second stage release rate is 35 csm. The weir length will be 54 feet. A total of 3.35 inches of runoff will be stored below the crest of the emergency spillway, which will be cut in earth and will be 200 feet wide. The sediment pool will have 129 acre feet of capacity, based on 100 year accumulation. The estimated construction cost of this dam is $118,303.

The above cost estimates include $2,000 for each of Sites 4, 5, and 6 to deepen shallow edges of the reservoir. Excavated material will be placed in islands and penisulas to benefit fish and wildlife. Also included in this estimate is the excavation of "gate holes" in the channels below each spillway, as a habitat for fish. The "gate holes" will be $\frac{1}{4}$ to 1 acre in size and 4 to 5 feet deep.

Structure Site 7 is located on Shipetauken Creek just upstream from Carter Road in Mercer County. It is a single purpose flood prevention dam, with a sediment storage capacity of 20 acre feet based on a 100 year evaluation. The sediment pool will cover 3 acres, based on a 50 year sediment accumulation. This site controls 2.9 square miles or 3.3 percent of the critical drainage area. The dam will be earth fill with a volume of 87,200 cubic yards. The height of fill will be 41 feet. The dam will have a two stage riser. The first stage release rate is 5 csm and the second stage release rate is 35 csm. The volume stored below the crest of the emergency spillway is 3.05 inches of runoff. The emergency spillway width is 200 feet, cut in earth and rock. The estimated construction cost is $117,400.

Structure Site 7A, located about $1\frac{1}{2}$ miles downstream from Site 7, is single purpose flood prevention with a sediment storage capacity of 24 acre feet, based on 100 year accumulation. The area of the sediment pool is 11 acres, which is the area required for the 100 year accumulation. It controls a total of 5.9 square miles, including 2.9 square miles above Site 7, representing 6.6 percent of the critical drainage area. The dam will be about 18 feet high and will consist of 54,700 cubic yards of earth fill. A two stage inlet will be utilized with the first stage releasing 5 csm and the second stage 35 csm. The total storage below the crest of the emergency spillway is 2.90 inches of runoff. The emergency earth spillway will be 300 feet wide. The estimated construction cost is $73,600.

Structure Site 15, a single purpose flood prevention structure, is located in Monmouth County on New Sharon Branch, about 2 miles upstream from the Mercer County line. The sediment storage capacity will be 45 acre feet based on a 100 year accumulation. The area of the sediment pool will be 14 acres, which is the area required for the 100 year accumulation. The site controls 1.7 square miles or 1.9 percent of the critical drainage area. The dam will consist of 12,100 cubic yards of earth fill which is about 15 feet high. It will have a two stage riser. The first stage will have a 5 csm release rate and the second stage will have a 40 csm release rate. A total of 2.65 inches of runoff will be stored below the crest of the emergency spillway. The emergency spillway will be 200 feet wide and cut in earth. The estimated construction cost is $30,800.

Structure Site 18 is multipurpose flood prevention-fish and wildlife. It is located in Monmouth County, about 3 miles upstream from Site 4, on the main stem. The permanent pool will have a surface area of about 22 acres. The requirement for sediment storage is 33 acre feet based on a 100 year accumulation. The dam controls 1.2 square miles or 1.4 percent of the critical drainage area. The earth fill is about 32 feet high and contains 35,500 cubic yards. The first stage of the proposed two stage riser will release 5 csm. The second stage has a release rate of 20 csm. Total storage below the crest of the emergency spillway will be 2.40 inches of runoff. The emergency earth spillway will be 50 feet wide. The estimated construction cost is $60,500.

Structure Site 19 is multipurpose flood prevention-fish and wildlife. It is located about $2\frac{1}{2}$ miles upstream from Site 4, on a tributary south of and roughly parallel to the main stem. The surface area of the permanent pool is about 56 acres. The sediment storage capacity will be 36 acre feet based on a 100 year accumulation. This site controls 1.8 square miles or 2.0 percent of the critical drainage area. The dam will be about 35 feet high and consist of 51,700 cubic yards of earth fill. It will have a two stage riser. The first stage release rate is 5 csm and the second stage release rate is 25 csm. The total volume stored below the emergency spillway crest is equal to 2.92 inches of runoff. The emergency spillway, 75 feet wide, will be cut in earth. The estimated construction cost is $93,500.

Structure Site 20 is a multipurpose flood prevention-recreation site. It is located on the main channel about 2,000 feet upstream from the Quaker Bridge Road. The surface area of the permanent pool will be about 200 acres. The sediment storage requirement is 130 acre feet based on a 100 year accumulation. The site controls 33.0 square miles, including 22.0 square miles above Site 6. This represents 36.9 percent of the critical drainage area. The dam will be 20 feet high, containing 64,200 cubic yards of fill. The reinforced concrete drop spillway will have two stages. The release rate for the first stage will be 5 csm and for the second stage 35 csm. The weir will be 75 feet long. The storage below the crest of the emergency spillway will be 3.57 inches of runoff. The emergency spillway will be 500 feet wide and cut in earth. The estimated construction cost is $267,500, including $50,000 for deepening shallow areas. The Jersey Central

Power and Light Company has a power line right-of-way that runs parallel to the permanent pool. Six of the steel high tension towers will require fill around them. The Public Service Gas and Electric Company has a transmission line crossing the reservoir site at right angles to the Jersey Central line. Costs for modification include rearranging a 26,000 volt pole line to span the proposed reservoir, placement of fill material and riprap around one steel tower, and extension of a maintenance road. Old Post Road crosses the reservoir in the vicinity of the Public Service transmission line. Modification cost include raising the road and installation of a new bridge.

Recreation facilites will be developed around Site 20. They will be capable of handling the expected peak load of 7,500 visitors a day. Access roads will be developed around the 200 acre reservoir. Recreation facilities include those for swimming, boating, fishing, picnicking, camping, and trails for hiking. They also provide for parking, sanitation, garbage disposal and electric power. Purchase of 904 acres around the reservoir for access roads and recreation facilities will be cost shared between Public Law 566 and local funds. The estimated construction cost of the recreation facilities is $933,300. See Table 2B for details and itemized costs of recreation facilities. See Figure 1 for a plan view of the recreational development.

Structure Site 21, a single purpose flood prevention site, is located on Miry Run, about 1,000 feet upstream from Hughes Drive. The sediment storage capacity will be 80 acre feet based on a 100 year accumulation. The area of the sediment pool will be 41 acres, also based on the 100 year sediment accumulation. The site controls 7.9 square miles or 8.8 percent of the critical drainage area. The dam will be about 17 feet high and will consist of 54,300 cubic yards of earth fill. The spillway will be a two stage reinforced concrete drop structure. The first stage release rate will be 5 csm and the second stage 50 csm. The weir length will be 30 feet. The total storage below the emergency spillway crest is 2.78 inches of runoff. The emergency spillway will be 600 feet wide, cut in earth. About 1,500 feet of blacktop township roads will be raised about 2 feet. The estimated construction cost of the dam is $92,900.

Figures 2 and 3 show sections of a typical floodwater retarding structure.

About 9.4 miles of stream channels on New Sharon Branch, Bridegroom Run and Hancock Creek will be improved by widening and deepening, at an estimated construction cost of $89,711. Channel capacities will be designed to carry at least the 5 year 24 hour flood. This volume is greater than the volume obtained from the B drainage curve, except in the extreme upper reaches, where it is equal to or greater than the C curve volume. With this capacity, and channel depths sufficient to provide adequate outlets for tile drains, very good drainage as well as the desired degree of flood protection for the crops grown will be afforded. Side slopes will be 1:1. Typical cross-sections are shown in Figures 4 and 5.

One floodwater retarding structure, Site 8, will control 28 percent

of the drainage area above the damage reach on Pond Run. This will be supplemented by about 2.4 miles of stream channel improvement.

Structure Site 8 is located on Pond Run in Mercer County, just upstream from Hamilton Square Road. Although it is a single purpose flood prevention structure, Hamilton Township will purchase about 235 acres around the structure for development into a park area. The surface area of the sediment pool is 13 acres, which is the area required for the 100 year accumulation. The requirement for sediment storage is 31 acre feet, based on a 100 year accumulation. The drainage area controlled is 3.0 square miles. The dam is about 19 feet high and contains 43,300 cubic yards of earth fill. The inlet will have 2 stages. The first stage will have a release rate of 5 csm and the second stage will release 35 csm. A volume equal to 3.16 inches of runoff will be stored below the crest of the emergency spillway. The emergency spillway, cut in earth, will be 400 feet wide. The construction cost is estimated at $69,700.

The 2.4 miles of channels on Pond Run will be improved, starting at its confluence with Assunpink Creek. The channel will be designed to carry the 100 year frequency storm.

About 1.9 miles of this channel will be lined with reinforced concrete. The remaining 0.5 mile will be earth. The estimated construction cost is $1,516,976. Figure 6 shows a typical section of the concrete channel and Figure 7 a profile of the channel.

Eight bridges will be underpinned and one building now straddling the channel will be removed. New culverts will be installed under the railroad. Also, water, gas and sewer lines, located mostly at the bridges will be modified to accomodate the improved channel. Minor realignment will be made to improve the hydraulic efficiency of the channel. Additional details and alternatives are described on page 54.

See Table 1, 2, and 3 for details on quantities, costs and design features of structural measures. Refer to Project Map for location of structures.

EXPLANATION OF INSTALLATION COSTS

Land Treatment

Costs for installation of land treatment measures were based on current costs for rental of contract equipment, and farm labor, equipment and materials.

Costs for technical assistance in installation of land treatment measures were based on analysis of records of Work Units and the New Jersey Bureau of Forestry.

The total cost of the land treatment program is $307,280, of which $271,280 is for cropland measures and $36,000 for forest land measures.

The $271,280 for cropland measures includes $42,676 of Public Law 566 funds for technical assistance by the Soil Conservation Service. The remaining $228,604 includes $26,400 of Soil Conservation Service technical assistance from the going program of SCS assistance to Soil Conservation Districts and $202,204 to be paid by landowners assisted by the Agricultural Conservation Program.

The $36,000 for the forest land treatment program includes $8,600 of Public Law 566 funds for technical assistance by the U. S. Forest Service and $27,400 of other funds. "Other" funds include $8,600 State funds for technical assistance, $1,800 State cost of planting stock above the selling price to landowners, $600 Cooperative Forest Management funds, and $16,400 installation cost to landowners with such help as may be available under the Agricultural Conservation Program.

Structural Measures

Construction costs for structural measures were based on calculated quantities of major bid items and estimated unit costs obtained from recent bid prices for similar construction items in this area. The cost estimate for minimum basic recreational facilities was made by Mercer County officials, based on past experience, with assistance from the U. S. Bureau of Outdoor Recreation and the Soil Conservation Service.

Estimated contract costs include an allowance of 12 percent for contingencies.

Installation services include costs for geological investigations, engineering surveys, final designs, supervision and inspection, and administrative overhead. Geological investigations will include samples for shear and permeability tests.

The cost for geological investigations was based on estimates of time and equipment rental rates, and on laboratory test rates. Costs for engineering surveys, designs and supervision and inspection were based on estimates of man days to complete this phase of installation, using cost records for similar work done in the past as a guide. Administrative costs were based on records kept by the state fiscal office for previous jobs. Installation services costs thus computed amount to 29 percent of construction cost estimates.

Land rights cost estimates were obtained from local assessors and other local sources. They range from $25 to $2,000 per acre, depending upon location and condition. Exceptions occur where the values are greater.

Costs for modification of the Public Service Gas and Electric Company and Jersey Central Power and Light Company transmission lines crossing Site 20 were obtained from consultations with representatives of the companies, through Mercer County officials. Cost for raising roads and replacement of a bridge associated with Structure Sites 20 and 21 were obtained from Mercer County officials. Cost for modification of gas, water and sewer lines crossing Pond Run were obtained from the Hamilton Township engineer. The cost estimate for new culverts

through the railroad fill on Pond Run was based on consultations with the U. S. Army Corps of Engineers and consulting firms. Pennsylvania Railroad officials concurred in the estimate. Costs for maintaining traffic during construction were provided by the Pennsylvania Railroad Company. These costs, estimated at $70,500, are included as part of the land, easements, and rights-of-way costs.

The estimate of costs for administration of contracts was obtained from the local contracting organizations, based on past experience.

Installation services costs for design, layout and supervising construction of minimum basic recreation facilities will be shared by P. L. 566 and other funds, each paying 50 percent of the actual payments for such services. However, no P. L. 566 funds will be provided for services performed by the regular staff of the sponsoring local organization.

The costs of land, easements and rights-of-way needed for water resource development and for installation of minimum basic facilities for the recreational development in Site 20 will be shared from Public Law 566 and other funds. Each will pay 50 percent of the payments made for acquiring 904 acres of land and for modification of South Post Road, the Jersey Central Power and Light Company transmission line and the Public Service Electric and Gas Company transmission line. The cost of acquiring an additional 45 acres located at the upper end of the flood detention pool, not having recreational value for this development, is allocated to flood prevention and is borne entirely from other than Public Law 566 funds. The cost of an additional 30 acres for recreational facilities, although allocated to recreation, will be borne by other than Public Law 566 funds. The Federal government will not share in the engineering, legal or administrative costs incurred by the local organization for acquiring land rights.

Installation costs for multiple purpose Sites 4, 5, 6, 18, 19 and 20 were allocated to each purpose by the "Use of Facilities" method. An estimated $2,000 per site of construction costs for pool modification in Site 4, 5, and 6, and $50,000 in Site 20 were treated as specific costs for fish and wildlife and recreation, respectively.

The allocation of installation costs of multipurpose reservoir structures to purposes and the Public Law 566 share for each purpose are shown below:

Site No.	Flood Prevention (Percent)	Recreation (Percent)	Fish and Wildlife (Percent)	P.L. 566 Share		
				Flood Prevention (Percent)	Recreation (Percent)	Fish and Wildlife (Percent)
4	75.4	-	24.6	74.4	-	47.8
5	50.6	-	49.4	66.4	-	44.1
6	92.1	-	7.9	76.3	-	50.2
18	62.8	-	37.2	94.4	-	61.2
19	41.0	-	59.0	90.9	-	58.5
20	9.9	90.1	-	78.5	49.1	-

Costs of the stream channel improvements on Bridegroom Run, Hancock Creek, and the tributaries of New Sharon Branch were allocated by the second alternative described in paragraph 1132.212 of the Watershed Protection Handbook. Costs for improvements on the main stem channel of New Sharon Branch were allocated by the first alternative method described in paragraph 1132.211 of the Handbook.

On this basis, 61.6 percent of the total costs is allocated to flood prevention and 38.4 percent to agricultural water management. Construction costs for flood prevention will be paid entirely from Public Law 566 funds. The construction costs for agricultural water management will be shared on a "fifty-fifty" basis between Public Law 566 and other funds. Installation services costs will be paid from Public Law 566 funds. Costs for land, easements and rights-of-way and administration of contracts will be paid from other funds.

The following is the proposed schedule of obligations:

Year	Structural Measures		Land Treatment		Total	
	P.L. 566	Other	P.L. 566	Other	P.L. 566	Other
1st	111,000	289,388	5,400	11,000	116,400	300,388
2nd	977,666	787,134	5,400	16,000	983,066	803,134
3rd	788,573	478,838	5,400	26,500	793,973	505,338
4th	673,131	280,679	5,400	26,500	678,531	307,179
5th	610,575	125,714	5,400	31,500	615,975	157,214
6th	601,053	121,878	5,400	31,500	606,453	153,378
7th	618,139	183,565	5,400	31,500	623,539	215,065
8th	137,161	75,019	5,400	31,500	142,561	106,519
9th	166,778	145,187	5,400	31,500	172,178	176,687
10th	89,414	942	2,676	18,504	92,090	19,446

EFFECTS OF WORKS OF IMPROVEMENT

Flood Prevention

Ten proposed structures will provide virtually complete protection to damage reach A on Assunpink Creek against the 100-year frequency storm. The benefits will accrue to 7 industrial plants, 21 residences, and 3 commercial establishments. Over 3,400 individuals and weekly payrolls in excess of $350,000 are involved. The proposed structures will eliminate the need of some industrial plants to protect industrial equipment several times a year by shutting it down and raising it above real or expected flood stages.

Structure Site 8, together with the stream channel improvements, will provide virtually complete protection against the 100-year frequency storm in damage reach B on Pond Run. Properties protected include 260 residences, 28 commercial establishments, and one large industry. Three acres of high value land will be enhanced.

With the project installed, a repeat of the 1938 storm would result in virtually no damages to damage reach A on Assunpink Creek and damage reach B on Pond Run.

Total area inundated from the 100 year frequency storm, which is 73 acres in reach A and 94 acres in reach B, will be reduced to little or nothing with the project installed. Flooding of the undeveloped

area between Site 8 and the start of channel improvement on Pond Run will be reduced to about 84 acres in the 100 year frequency storm and to about 10 acres in the 10 year frequency storm. See map on page for delineation of areas that will still be inundated by the 10 year and the 100 year frequency storms.

Agricultural Water Management

The proposed stream channel improvement on New Sharon Branch, Bridegroom Run and Hancock Creek will provide more rapid disposal of runoff and adequate outlets for tile drains affecting 557 acres of cropland and 139 acres of woodland. Benefits will accrue to 28 landowners in the form of increased net income from more intensive use of the land and from higher yields of the crops now grown. Some of the land will change from grassland to truck cropland, whereas other grassland will remain as such, but yield and quality will be improved. The improved channels will allow presently ineffective tile lines to again become operative. Flooding at the 5-year frequency will be limited to small areas for periods of short duration. These areas are expected to be used less intensively than the remainder of the benefited areas. It is not anticipated that there will be any new land brought into production. Major crops benefited are potatoes, vegetables, and soybeans, none of which is covered by price support and allotment programs.

Fish and Wildlife

Installation of multipurpose structures 4, 5, 6, 18 and 19 will provide much needed fish and wildlife habitat improvement and public fishing and hunting. In addition to providing water for fish, the reservoirs will provide resting places for migrating ducks. The gate holes to be installed below the dams of Sites 4, 5 and 6 will provide relatively deep turbulent pools for fish habitat. The New Jersey Department of Conservation and Economic Development will purchase several thousand acres around these sites through the New Jersey Green Acres Program. The 406 acres of water in these reservoirs will be stocked with warm water game fish or trout, depending upon the suitability of the waters. It is estimated that the use of these sites will be 49,400 visitor days a year for hunting and fishing. Sufficient land will be acquired along Assunpink Creek to provide continuous public access between all of these sites and Site 20 downstream.

Recreation

The public recreational development in Site 20 will provide much needed recreation for heavily populated Mercer County and adjacent areas. Mercer County will acquire fee simple title and permanent easements to about 979 acres of land around this site. This will be acquired in cooperation with the New Jersey Green Acres Program. Public access will be continuous with the State owned developments upstream. The 200 acre reservoir will be stocked with warm water game fish. Facilities will be developed for fishing, boating, swimming, picnicking, camping, hiking and ice skating. It is estimated that these facilities will accomodate 260,000 visitor days a year, with a peak use of 7,500 visitors a day. Most of the recreational use will take place between

the latter part of May and early September. However, some activities will occur during the entire year. Other recreational facilities on adjacent land will include golfing, tennis, horseback riding and an outdoor arena. Approximately 1,000 additional acres are involved.

Hamilton Township will purchase about 235 acres of land around Site 8, a floodwater retarding structure with a 13 acre sediment pool. The area will be developed for swimming, fishing, picnicking, and ice skating. It is estimated that this will attract 6,000 visitor days a year. Other planned recreation includes tennis, playground facilities, organized sports, and an amphitheatre. Park facilities will include an administration building, about $2\frac{1}{2}$ miles of roads, and a Volunteer Fireman Training Center.

The Township plans to develop the above named facilities in 5 stages over a 10 year period. The first stage is construction of the reservoir, around which the other facilities will be planned.

Effects on General Economy

The effects of the overall project will be to stimulate the local economy. Local labor, equipment and materials will be utilized in construction of structural measures. The recreational developments, themselves, will provide lasting opportunities for increased economic activities. Sales and service of boats, motors, picnic and camping equipment, and other recreational items will be increased many fold. Operation and maintenance of both the structural measures and the recreation facilities will result in substantial and lasting use of local labor, equipment and supplies.

Increased agricultural production will result in increased utilization of labor, equipment and materials in the production, processing and sale of farm products. Improved efficiency of farm operations will be realized by the farm families affected by the improved drainage and protection from flooding.

Much of the increased economic activity resulting from the project will be felt in rural areas in need of this stimulant. Monmouth County has been designated as a 5A area by the Area Redevelopment Administation.

PROJECT BENEFITS

Floodwater Reduction

Flood damages will be reduced $145,422 annually in the Assunpink Creek damage reach A, between Whitehead Mill Pond and Oak Street. Of these benefits, $142,805 are attributed to structural measures and $2,617 to land treatment measures.

Structure Site 8, together with 2.4 miles of stream channel improvement will provide floodwater and associated sediment reduction benefits to 70 residences, 6 commercial establishments and one industry in reach B along the Pond Run tributary. Damages occur annually and

sometimes more than once a year from flash storms. Also, benefits will accrue to 3 acres of land in the form of changed land use. Other benefits include recreational use of water in the permanent pool of floodwater retarding structure Site 8. Of the $93,360 average annual benefits on Pond Run, $2,075 are attributed to land treatment, $3,000 to incidental recreation, and $88,285 to structural measures.

The $231,090 average annual flood prevention benefits from structural measures on Assunpink Creek and Pond Run include $182,334 direct, $30,523 indirect, and $18,233 secondary benefits. Indirect benefits result from reducing losses associated with detouring traffic and otherwise upsetting daily routine. Secondary benefits estimated at 10 percent of the direct primary benefits are expected to accrue within the zone of influence of the project. These include additional economic activities of buyers, shippers and suppliers of the additional goods and services made possible by the project.

Secondary benefits from a national viewpoint were not considered in the evaluation.

Redevelopment benefits were not evaluated.

In the August 1955 storm the Delaware River reached a stage that caused damages upstream on the Assunpink to the vicinity of South Broad Street. This project will have negligible effect on Delaware River flood stages, hence such damages will not be alleviated.

There are intangible benefits that cannot be evaluated in monetary terms. The danger of loss of life, as occurred in the storm of 1882, certainly cannot be overlooked. There is also the feeling of security that goes with knowledge of being protected against devastating floods.

Agricultural Benefits

The stream channel improvement measures proposed for installation on New Sharon Branch will provide flood prevention and agricultural water management benefits to 290 acres of cropland. Channels are designed to adequately dispose of storm runoff and to provide depth for outletting existing and proposed on-farm tile drains. Increased yields and net income from truck crops, potatoes, soybeans, field corn and hay will be realized. Annual direct identifiable benefits amount to $17,381 of which $11,212 are flood prevention and $6,169 are agricultural water management benefits. Secondary agricultural benefits amount to $2,072 annually, and are included for project justification. These fall in two categories, those stemming from the project and those induced by the project. Those stemming from the project include benefits from increased activities associated with the increased production. Those induced by the project are based on the increased associated costs that producers will incur in connection with increased production.

Stream channel improvement measures proposed for Bridegroom Run will provide flood prevention and agricultural water management benefits to 179 acres of cropland. Crops benefited are potatoes, soybeans, field corn, truck crops, and hay. Increased yields of these crops will

result from greater capacity to dispose of storm runoff and sufficient depth to provide outlets for existing and proposed tile drains. Annual direct identifiable benefits amount to $12,027, of which $6,013 are flood prevention and $6,014 are agricultural water management benefits. Secondary agricultural benefits amounting to $1,409 annually are used for project justification.

Stream channel improvement measures proposed for Hancock Creek will provide flood prevention and agricultural water management benefits to 88 acres of cropland. Crops benefited are potatoes, soybeans, field corn, truck crops and hay. Benefits will accrue from increased yields of these crops due to adequate capacity for disposal of storm runoff and sufficient depth for outletting tile drains. Direct identifiable benefits amount to $5,743 annually, $2,871 of which are flood prevention benefits and $2,872 agricultural water management benefits. Secondary agricultural benefits amounting to $675 annually are used for project justification.

About 28 landowners will be directly affected by the proposed stream channel improvements on New Sharon Branch, Bridegroom Run and Hancock Creek.

Other benefits from stream channel improvement measures, although not evaluated, accrue to 139 acres of woodland. It is believed that mosquito control benefits will be substantial. The cost of maintaining one mile of public roads will be lessened because of the lower water table and less frequency of inundation.

Redevelopment benefits were not computed, hence were not used for project justification.

Fish and Wildlife

Planned fish and wildlife benefits will be realized from Sites 4, 5, 6, 18 and 19 containing 406 acres of water surface. Wildlife habitat enhancements are considered equal to costs. Hunting and fishing will provide other benefits. It is estimated that these sites will attract 49,400 visitor-days annually. After taking associated costs into consideration, the estimated average annual benefit from hunting and fishing is $22,965.

Recreation

Reservoir Site 20 has been selected for recreational development, on which the Federal Government will cost-share in acquiring land, easements and rights-of-way; and in installation of minimum basic facilities. Recreation developed around this 200-acre reservoir will consist of facilities for picnicking, camping, swimming, boating, fishing, ice skating, and other forms of recreation. It is estimated that it will attract 260,000 visitor-days annually. At $1.50 per day, benefits amount to $390,000 annually.

Incidental recreational benefits will be realized from flood prevention Site 8, containing 13 acres of surface water. About 235 acres

of land around the site will be developed for recreational use and opened to the public for fishing, ice-skating, picnicking, and other types of recreation. The estimate of annual visitor-days is 6,000. At $.50 per visitor day, benefits amount to $3,000 annually.

COMPARISON OF BENEFITS AND COSTS

Average annual primary benefits from all structural measures are estimated at $663,973, as compared to average annual costs, estimated at $302,120, a benefit-cost ratio of 2.2 to 1.0.

Average annual benefits including local secondary benefits from all structural measures are estimated at $686,362, as compared to average annual costs of $302,120, a benefit-cost ratio of 2.3 to 1.0.

See Table 6 for details on benefit-cost computations.

PROJECT INSTALLATION

The Mercer County and Freehold Soil Conservation Districts will cooperate with landowners and operators in carrying out the accelerated land treatment program over a period of 10 years. Technical assistance will be provided by the Soil Conservation Service to District cooperators for planning and installation of those measures for which the Soil Conservation Service is responsible. The New Jersey Bureau of Forestry, in cooperation with the U. S. Forest Service, will provide technical assistance for installation of the forest land measures.

At least 50 percent of the agricultural land in the drainage area above each reservoir structure will be under cooperative agreement with the Soil Conservation Districts prior to initiation of construction.

The Mercer and Monmouth County Agricultural Stabilization and Conservation Committees will provide financial assistance to landowners and operators, within the needs and funds available, for installation of those measures which will accomplish the conservation objectives.

The Farmers Home Administration will provide soil and water conservation loans to all eligible landowners requesting them.

The Soil Conservation Service will provide technical assistance in the design of structural measures, preparation of specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificates of completion, and performance of related activities in the establishment of the planned structural measures. Included is installation of culverts under the Pennsylvania Railroad.

The New Jersey Agricultural Extension Service, through the Mercer and Monmouth County Agricultural Agents, will assist the sponsors in carrying out an information and education program. This program will be directed toward developing an understanding and appreciation of the overall objectives of the program by the people in the watershed.

Mercer County will acquire the necessary land, easements and rights-of-way for Sites 20 and 21 and for the stream channel improvement measures on Bridegroom Run, Hancock Creek and that part of New Sharon Branch within Mercer County. The County will provide the Jersey Central Power and Light Company with needed rights for ingress and egress to maintain their towers. The Soil Conservation Service, through Public Law 566 funds, will participate to the extent of providing 50 percent of the cost of acquiring 904 acres of land in Site 20, except the acquisition costs of surveys and legal fees; 50 percent of the cost of installing minimum basic facilities; and 50 percent of the cost of relocation and modification of existing facilities. The County will provide the local share of construction costs for the above stream channel improvement measures and for Site 20. The County will also administer contracts for Sites 6, 20 and 21, and for the above mentioned stream channel improvements.

The Township of Hamilton will acquire the necessary land, easements and rights-of-way for Site 8 and for channel improvement measures on Pond Run. The Township will administer contracts for the above measures, including the underpinning of bridges and jacking the culverts through the railroad. The Pennsylvania Railroad Company will be furnished detailed plans and specifications showing the proposed installation of culverts under the railroad for their approval. The Township will enter into an agreement with the Pennsylvania Railroad Company pertaining to the installation of the culverts, including the needs for personnel, materials and equipment to maintain traffic during installation.

The Mercer County Soil Conservation District will acquire the necessary land, easements, and rights-of-way for Sites 7 and 7A, and will administer contracts for these sites.

The area between Princeton Pike and Site 7A dam will be zoned against encroachment of buildings.

The New Jersey Department of Conservation and Economic Development will acquire the necessary land, easements and rights-of-way for Sites 4, 5, 6, 18, and 19. The Department will finance the local share of construction costs and the entire cost of providing public access. It will administer contracts for these structures.

Monmouth County will acquire the land, easements and rights-of-way for Site 15 and for the Monmouth County part of the stream channel improvement measures on New Sharon Branch. The County will provide the local share of construction cost and will administer the contracts.

Since a number of the floodwater retarding structures are in series with one another, a specific order of construction should be adhered to. Sites 18 and 19 should be constructed prior to Site 4, in order to assure structural safety of the latter. Similarly, Sites 4, 5, and 15, should be constructed prior to Site 6; Site 6 prior to Site 20; and Site 7 prior to Site 7A.

The sponsoring local organizations have the power of eminent domain

and have agreed to use such powers if necessary to acquire the needed land, easements and rights-of-way.

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out the works of improvement as described in the work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act, Public Law 566 (83d cong., 68 Stat. 666) as amended.

Cost sharing assistance for installation of land treatment measures will be made available to eligible landowners and operators, consistent with needs and funds available, through the Agricultural Conservation Program.

The Farmer's Home Administration will provide loans to eligible farmers requesting them for installing land treatment measures. The sponsors will not request FHA loans for installation of structural measures.

The New Jersey Green Acres Program was passed by referendum in 1960. It provided an appropriation of $60,000,000 for the purchase of land for open spaces by the State, and by County and Municipal governments with matching State funds.

Sites 4, 5, 6, 18 and 19, will be acquired by the New Jersey Department of Conservation and Economic Development with Green Acres funds. Acquisition will include the connecting flood plain, additional higher land around these sites and the connecting flood plain between Sites 6 and 20. The non-Federal share of construction costs will be paid by the Department from funds budgeted for that purpose.

Site 20 will be acquired with Green Acres funds by the State and Mercer County on a matching funds basis. This will result in continuous public access between Sites 4, 5, 6, 18, 19 and 20. The non-Federal share of costs for modification of existing facilities, installation of minimum basic recreation facilities, and construction costs will be financed by issuance of General Government Bonds. This being a recreational development, the above costs for Site 20 will be shared from Public Law 566 funds.

Most of Site 8 will be acquired through the Green Acres program by Hamilton Township in cooperation with the State, on a matching funds basis. Easements will be obtained for the remainder of the land. Township funds will be budgeted for this purpose.

The cost of acquiring necessary land, easements and rights-of-way for Site 21 will be paid by Mercer County from funds budgeted for this purpose.

Land, easements and rights-of-way for Sites 7 and 7A will be acquired by the Mercer County Soil Conservation District from funds solicited for that purpose.

Hamilton Township will acquire the necessary land, easements and rights-of-way for installation of the channel improvement measures on Pond Run from funds budgeted for this purpose.

The non-Federal share of construction costs for stream channel improvement measures on Bridegroom Run, Hancock Creek and the Mercer County portion of New Sharon Branch will be paid by Mercer County from funds appropriated to the Mosquito Control Commission. The County will also acquire the necessary land, easements and rights-of-way, which are expected to be donated. A new culvert across South Lane on Bridegroom Run will be installed by the County from road and bridge funds.

Monmouth County will acquire the necessary land, easements and rights-of-way for Site 15 and the stream channel improvement measures in the Monmouth County portion of New Sahron Branch. The cost of deepening one dugout pond which will be adversely affected by the channel improvement will be paid from funds budgeted for the purpose. All other easements are expected to be donated. The non-Federal share of construction cost will be paid by Monmouth County from funds budgeted for the purpose. The County will be assisted by Upper Freehold Township for part of the cost.

The Public Law 566 share of land, easements and rights-of-way, recreation facilities and construction costs is estimated at $3,745,338. The local sponsoring organizations understand that all necessary land, easements and rights-of-way must be obtained or be assured by condemnation proceedings before Federal money is made available.

Technical assistance for installation of land treatment measures will be made available from Public Law 566 funds. The costs of technical assistance for forest land treatment measures will be shared by the State and Federal Government. Federal financial assistance is contingent upon funds appropriated under the Act.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by landowners and operators under cooperative agreements with the Freehold and Mercer County Soil Conservation Districts. Forest land treatment measures will be maintained by the landowners or operators with technical assistance provided by the New Jersey Bureau of Forestry, in cooperation with the U. S. Forest Service through the Cooperative Forest Management Program.

Maintenance of the reservoir structures will include mowing the dam and emergency spillway areas, removal of trash interfering with the spillway, repair of any damage to the dam or spillways, and periodic replacement of deteriorated parts of the structure. Operation and maintenance of multipurpose flood prevention-fish and wildlife structures includes policing and clean up, and maintenance of access roads and parking lots. Operation and maintenance of the recreational development will include policing and clean up, repair of access roads and parking lots, repair and replacement of minimum basic facilities, and scheduling of use and admission fees.

Costs for clean up include a team of two men with a truck twice a week during the period from April to August and once a month during the remainder of the year.

Costs for maintenance of recreational facilities include replacing the following items once during the project life of 100 years: one bridge, bathhouse, concrete ramp, three timber docks, all picnic facilities, camp sites, water supply facilities and sanitary facilities. They include replacing the incinerator and signs $1\frac{1}{2}$ times and four culverts four times during the project life.

Maintenance of stream channel improvement measures will consist of removing fallen trees and other debris, periodic removal of silt deposits, and repair of any damage to the concrete channel structure on Pond Run.

Mercer County will operate and maintain reservoir Sites 20 and 21; recreation facilities on Site 20; and stream channel improvement measures on Bridegroom Run, Hancock Creek, and that part of New Sharon Branch within Mercer County. The estimated annual cost is $60,248. This includes $58,927 for recreational facilities on Site 20. Funds will be budgeted for that purpose. The recreation facilities will be handled through the Mercer County Park Commission and the channel improvement measures through the Mercer County Mosquito Control Commission. The Park Commission will set up a schedule of fees for use of certain facilities. These will not produce revenue in excess of that needed to pay off the initial investment and provide for operation and maintenance. The schedule of fees must be agreed to by the Soil Conservation Service.

Hamilton Township will maintain Site 8 estimated to cost $260 annually, and stream channel improvement measures on Pond Run, estimated to cost $725 annually, from funds budgeted for that purpose.

The New Jersey Department of Conservation and Economic Development will operate and maintain Sites 4, 5, 6, 18 and 19 from funds budgeted for that purpose. The annual cost is estimated at $8,303 including policing and clean up.

Monmouth County will maintain Site 15, estimated to cost $199 annually, and that part of New Sharon Branch within the ~~Township,~~ County, estimated at $937 annually. Funds will be budgeted for that purpose.

The Mercer County Soil Conservation District will maintain Sites 7 and 7A. The estimated cost is $600 annually and will be paid from funds solicited for that purpose.

The overall operation and maintenance cost of the project is $71,272 annually.

All structural measures will be inspected after each major storm, and at least once a year. Written inspection reports will be prepared by each of the responsible sponsors and made available to the Soil Conservation Service at any time. Representatives of the responsible

organizations will jointly make the annual inspection with the Soil Conservation Service. They will jointly determine what maintenance measures are needed. The Soil Conservation Service will provide design information and technical assistance that may be available and needed in performing maintenance work.

An operation and maintenance agreement between the Soil Conservation Service and the responsible local organizations will be executed prior to issuance of invitations to bid.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Assunpink Creek Watershed, New Jersey

Installation Cost Item	Acres 1/ to be Treated	Unit	Number	Estimated Cost - (Dollars) 2/ P. L. 566	Other	Total
LAND TREATMENT						
Soil Conservation Service						
Cropland	14,813				202,204	202,204
Technical Assistance				42,676	26,400	69,076
SCS Subtotal				42,676	228,604	271,280
Forest Service						
Woodland	675				18,200	18,200
Technical Assistance				8,600	9,200	17,800
FS Subtotal				8,600	27,400	36,000
TOTAL LAND TREATMENT				51,276	256,004	307,280
STRUCTURAL MEASURES						
Soil Conservation Service						
Floodwater Retarding Structures		No.	5	384,400		384,400
Dams, Multipurpose		No.	6	603,981	119,222	723,203
Basic Recreation Facilities		No.	1	466,650	466,650	933,300
Stream Channel Improvements		Mi.	11.8	1,589,583	17,104	1,606,687
Subtotal - Construction				3,044,614	602,976	3,647,590
Installation Services						
Soil Conservation Service						
Engineering Services				550,799	116,663	667,462
Other				399,527		399,527
Subtotal - Installation Services				950,326	116,663	1,066,989
Other Costs						
Land, Easements & R/W				778,550	1,728,408	2,506,958
Administration of Contracts					18,269	18,269
Legal Fees					22,028	22,028
Subtotal - Other				778,550	1,768,705	2,547,255
TOTAL STRUCTURAL MEASURES				4,773,490	2,488,344	7,261,834
TOTAL PROJECT				4,824,766	2,744,348	7,569,114
SUMMARY						
Subtotal SCS				4,816,166	2,716,948	7,533,114
Subtotal FS				8,600	27,400	36,000
TOTAL PROJECT				4,824,766	2,744,348	7,569,114

1/ Non-Federal Land
2/ Price Base 1964

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Assunpink Creek Watershed, New Jersey

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
Cons. Cropping Systems	Ac.	5,275	75,120
Contour Farming	Ac.	743	5,944
Cover and Green Manure	Ac.	6,276	106,692
Crop Residue Use	Ac.	2,795	11,180
Diversions	Ft.	14,300	1,484
Drainage Mains and Laterals	Ft.	52,672	26,336
Grass Waterway or Outlet	Ac.	13	3,616
Land Smoothing	Ac.	15	6,000
Stripcropping (Field)	Ac.	768	9,216
Tile Drains	Ft.	210,422	67,369
Tile System Structure	No.	13	520
Tree Planting	Ac.	22 2/	900
Hydrologic Cultural Operations	Ac.	118 2/	800
TOTAL	-	-	315,177

July, 1964

1/ Price Base 1964
2/ 6-yr. period (FY 1958-63)

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Assunpink Creek Watershed, New Jersey
(Dollars) 1/

Structure	Installation Cost - P.L. 566 Funds					Installation Cost - Other Funds						Total Instal. Cost
	Con-struction	Installation Services		L., E., & R/W	Total P.L. 566	Con-struction	Instal. Services	Other			Total Other Funds	
		Engineering	Other					Adm. of Cont.	L., E., & R/W	Legal Fees		
Floodwater Retarding Structures												
Site 7	117,400	23,242	19,136	----	159,778	---	---	587	74,000	---	74,587	234,365
Site 7A	73,600	19,458	13,174	---	106,232	---	---	368	144,000	---	144,368	250,600
Site 8	69,700	16,937	12,477	---	99,114	---	---	305	215,288	---	215,593	314,707
Site 15	30,800	10,184	5,683	---	46,667	---	---	154	14,500	---	14,654	61,321
Site 21	92,900	20,252	16,650	---	129,802	---	---	419	64,400	---	64,819	194,621
Subtotal	384,400	90,073	67,120	---	541,593	---	---	1,833	512,188	---	514,021	1,055,614
Dams, Multipurpose												
Site 4 (Joint Cost)	105,467	25,065	19,837	---	150,369	14,233	---	607	56,000	---	70,840	221,209
(Specific Cost) 2/	1,000	418	---	---	1,418	1,000	---	---	---	---	1,000	2,418
Site 5 (Joint Cost)	45,259	15,802	11,045	---	72,106	14,441	---	309	43,500	---	58,250	130,356
(Specific Cost) 2/	1,000	530	---	---	1,530	1,000	---	---	---	---	1,000	2,530
Site 6 (Joint Cost)	112,337	25,608	19,283	---	157,228	3,966	---	592	49,600	---	54,158	211,386
(Specific Cost) 2/	1,000	440	---	---	1,440	1,000	---	---	---	---	1,000	2,440
Site 18	49,232	14,604	10,830	---	74,666	11,268	---	303	4,800	---	16,371	91,037
Site 19	65,903	20,983	16,737	---	103,623	27,597	---	468	12,700	---	40,765	144,388
Site 20 (Joint Cost)	197,783	57,473	30,228	545,300	830,784	19,717	---	1,008	612,800	14,362	647,887	1,478,671
(Specific Cost) 3/	25,000	5,925	---	---	30,925	25,000	---	---	---	---	25,000	55,925
Subtotal	603,981	166,848	107,960	545,300	1,424,089	119,222	---	3,287	779,400	14,362	916,271	2,340,360
Basic Recreational Facilities	466,650	116,662	---	233,250	816,562	466,650	116,663	4,667	278,250	7,666	873,896	1,690,458
Subtotal	466,650	116,662	---	233,250	816,562	466,650	116,663	4,667	278,250	7,666	873,896	1,690,458
Stream Channel Improvement												
Pond Run	1,516,976	157,197	207,814	---	1,881,987	---	---	7,585	145,700	---	153,285	2,035,272
New Sharon Branch	60,375	15,714	13,542	---	89,631	13,025	---	734	9,100	---	22,859	112,490
Bridegroom Run	9,990	2,961	2,524	---	15,475	3,331	---	133	2,620	---	6,084	21,559
Hancock Creek	2,242	1,344	567	---	4,153	748	---	30	1,150	---	1,928	6,081
Subtotal	1,589,583	177,216	224,447	---	1,991,246	17,104	---	8,482	158,570	---	184,156	2,175,402
GRAND TOTAL	3,044,614	550,799	399,527	778,550 4/	4,773,490	602,976	116,663	18,269	1,728,408 5/	22,028	2,488,344	7,261,834

July, 1964

1/ Price Base 1964

2/ Deepening shallow areas of recreation pool and construction of gate holes below dams.

3/ Deepening shallow areas of recreation pool.

4/ Includes $100,550 for modification of existing facilities.

5/ Includes $186,550 for modification of existing facilities.

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Assunpink Creek Watershed, New Jersey

(Dollars) 1/

Item	Purpose				Total
	Flood Prevention	Drainage	Fish & Wildlife	Recreation	
		COST ALLOCATION			
Sites 7, 7A, 8, 15, 21, Pond Run Stream Channel Improvement	3,090,886				3,090,886
Site 4	168,606		55,021		223,627
Site 5	67,290		65,596		132,886
Site 6	196,970		16,856		213,826
Site 18	57,126		33,911		91,037
Site 19	59,156		85,232		144,388
Site 20 2/	250,693			2,974,361	3,225,054
Stream Channel Improvement:					
New Sharon Branch	72,567	39,923			112,490
Bridegroom Run	10,779	10,780			21,559
Hancock Creek	3,040	3,041			6,081
Total	3,977,113	53,744	256,616	2,974,361	7,261,834
		COST SHARING			
P.L. 566	3,179,544	31,184	134,358	883,103	4,773,490
Other	797,569	22,560	122,258	2,091,258	2,488,344
Total	3,977,113	53,744	256,616	2,974,361	7,261,834

July, 1964

1/ Price Base 1964
2/ Includes basic recreational facilities.

TABLE 2B - BASIC RECREATION FACILITIES

Assunpink Creek Watershed, New Jersey

Item	Unit	Number	Unit Cost (Dollars)	Cost (Dollars)
Access				
Gravel Road	Mile	4	24,000	96,000
Bridge	No.	1	60,000	60,000
Culverts	No.	5	2,000	10,000
Parking Lots	Car	1,000	75	75,000
Swimming				
Beach	Acre	5	10,000	50,000
Bathhouse	No.	1	40,000	40,000
Fishing				
Earth Jetties	No.	5	1,500	7,500
Boat Ramp & Docks				
Docks	No.	3	11,500	34,500
Ramp	No.	1	2,000	2,000
Parking	Car (with trailor)	150	90	13,500
Signs	Job	1	1,300	1,300
Picnicking				
Picnic Units	Unit	100	400	40,000
Shelters	No.	4	6,000	24,000
Camp Sites	Unit	100	1,250	125,000
Foot Paths	L.F.	25,000	0.40	10,000
Water Supply	Job	1	67,000	67,000
Sanitation	Job	1	225,000	225,000
Garbage & Rubbish Disposal Plant	Job	1	10,000	10,000
Planting & Stabilizing	Job	1	7,500	7,500
Electric Power	Job	1	35,000	35,000
TOTAL				933,300

July, 1964

TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING AND MULTIPURPOSE STRUCTURES
Assunpink Creek Watershed, New Jersey

Item	Unit	STRUCTURE NUMBER											TOTAL
		4	5	6	7	7A	8	15	18	19	20	21	
Drainage Area	sq.mi.	6.28[1]	1.57	9.52[1]	2.93	3.00[1]	2.99	1.68	1.21	1.77	10.96[1]	7.94	49.85
Storage Capacity													
Sediment	ac.ft.	108	31	129	20	24	31	45	33	36	130	80	667
Floodwater	ac.ft.	1222	351	1701	477	464	504	237	154	275	2087	1177	8649
Recreation	ac.ft.	415	358	134	-	-	-	-	111	448	491	-	1957
Total	ac.ft.	1745	740	1964	487	488	535	282	298	759	2708	1257	11273
Between high & low stages	ac.ft.	647	181	823	361	261	285	142	131	188	719	564	4302
Surface Area													
Sediment Pool[4]	ac.	46	20	48	3	11	13	14	7	8	68	41	279
Floodwater Pool	ac.	305	203	395	57	114	136	73	35	79	630	238	2265
Recreation Pool	ac.	120	126	82	-	-	-	-	22	56	200	-	606
Volume of Fill	cu.yd.	52057	13412	53370	87221	54683	43300	12147	35489	51732	64250	54300	521961
Elevation Top of Dam	ft.	113.0	108.3	92.9	143.6	81.5	78.4	118.3	173.1	163.9	73.6	78.3	
Maximum Height of Dam	ft.	20.4	13.6	22.7	41.0	18.5	19.1	14.6	32.1	35.4	20.3	17.5	
Emergency Spillway													
Crest Elevation	ft.	108.9	106.1	89.2	136.6	76.6	74.2	115.7	169.5	160.1	69.5	73.7	
Bottom Width	ft.	200	50	200	200	300	400	200	50	75	500	600	
Type		Earth	Earth	Earth	Rock	Earth	Earth	Earth	Earth	Earth	Earth	Earth	
Percent Chance of Use		1	1	1	1	1	1	1	1	1	1	1	
Avg. Curve No.-Cond. II		75	80	80	76	75	78	75	58	66	80	80	
Emergency Spillway Hydrograph													
Storm Rainfall (6-hr.)	in.	8.7[2]	7.8	9.6[3]	10.5	7.8	10.5	7.8	7.8	7.8	12.9[3]	10.5	
Storm Runoff	in.	5.67[2]	5.44	7.14	7.47	4.98	7.75	4.86	2.97	3.84	10.33	8.00	
Velocity of Flow (Vc)	ft/sec	5.2	3.4	4.5	7.6	6.3	5.4	4.4	4.6	4.6	5.1	5.2	
Discharge Rate	cfs	1230	139	2125	2740	2700	1665	630	233	322	4690	3680	
Max. W.S. Elevation	ft.	110.5	106.8	90.5	139.8	78.9	75.9	116.9	170.8	161.4	71.1	75.4	
Freeboard Hydrograph													
Storm Rainfall (6-hr.)	in.	15.4[2]	13.7	16.8[3]	26.0	13.7	26.0	13.7	13.7	13.7	31.9[3]	26.0	
Storm Runoff	in.	12.02	11.11	14.14	22.55	10.52	22.90	10.38	7.70	9.01	29.08	23.22	
Velocity of Flow	ft/sec	8.8	6.2	8.4	11.5	9.7	9.0	6.8	8.1	8.4	8.8	9.3	
Discharge Rate	cfs	4740	473	6600	10320	9220	9126	2100	1028	1602	15460	17150	
Max. W.S. Elevation	ft.	113.0	108.3	92.9	143.6	81.5	78.4	118.3	173.1	163.9	73.6	78.3	
Principal Spillway													
Capacity-Low Stage	cfs	62.0	10.7	151.0	21.3	39.5	19.9	11.2	8.1	12.0	220.0	54.3	
Capacity-High Stage	cfs	305.0	56.3	974.0	153.1	311.0	145.3	98.0	30.6	55.7	1483.0	568.0	
Capacity Equivalents													
Sediment Volume	in.	0.32	0.37	0.25	0.13	0.15	0.19	0.50	0.51	0.38	0.22	0.19	
Detention Volume	in.	3.65	4.18	3.35	3.05	2.90	3.16	2.65	2.40	2.92	3.57	2.78	
Spillway Storage	in.	4.57	6.20	3.44	2.98	4.91	3.98	2.46	2.08	3.50	5.64	3.48	
Class of Structure		b	b	b	c	b	c	b	b	b	c	c	

1/ Structures in series above; 2/ 8-hr. Duration; 3/ 10-hr. Duration

4/ Structures 7A, 8, 15 and 21 have 100-yr. sediment accumulation allocated to the permanent pool.

July, 1964

TABLE 3A - STRUCTURE DATA
CHANNEL IMPROVEMENT
(Agri. Channels)

Assunpink Creek Watershed, New Jersey

Channel Designation	Station Numbering For Reach		Watershed Area (sq. mi.)	6/ Required Capacity (cfs)	Manning's "n" Value Design	Channel Design		Design Water Surface Elev. (MSL Datum)		3/ Design Depth (ft)	Flow Area At Design Depth (sq ft)		Planned Hyd. Gradient (ft/ft)	Channel Velocity		Planned Cap. At Design Depth (cfs)	Vol. of Excav. (1000 cu yd)
						Bot. Width (ft)	Side Slopes							Design Depth ft/sec	5-Yr. Freq. ft/sec		
	Station	Station						Foot	Head		Channel	Floodplain					
New	22+15	33+15	6.29[1]	283.5[2]	0.035	20	1:1	87.00	87.20	4.5	100.1	468.0	0.00018	1.45	1.45	285.5	1.58
Sharon	33+15	71+30	6.29[1]	283.5[2]	0.035	20	1:1	87.20	91.40	4.0	96.0	-	0.00110	2.97	2.97	285.1	14.08
Branch	71+30	71+70	4.78[1]	199.3[2]	Bridge								*0.04000				0.17
	71+70	118+00	4.78[1]	199.3[2]	0.035	16	1:1	91.44	95.38	4.0	80.0	-	0.00085	2.53	2.53	202.4	14.26
	118+00	126+25	3.00[1]	89.9[2]	0.035	9	1:1	95.38	95.79	4.0	52.0	-	0.00050	1.78	1.78	92.6	1.77
	126+25	126+55	3.00[1]	89.9[2]	Bridge								*0.02000				0.06
	126+55	131+00	3.00[1]	89.9[2]	0.035	9	1:1	95.81	96.03	4.0	52.0	-	0.00050	1.78	1.78	92.6	0.97
	131+00	152+00	1.20	73.8	0.035	7	1:1	96.03	97.08	4.0	44.0	-	0.00050	1.70	1.70	74.8	3.77
	152+00	158+00	0.32	22.0	0.035	3	1:1	97.08	97.30	3.2	19.8	-	0.00036	1.12	1.12	22.2	0.46
	158+00	162+00	0.32	22.0	0.035	3	1:1	97.30	98.10	2.1	10.7	-	0.00200	2.14	2.14	22.9	0.21
	162+00	171+60	0.32	22.0	0.035	3	1:1	98.10	100.98	1.9	9.3	-	0.00300	2.51	2.51	23.3	0.51
Lat. #1	0+00	6+00	0.26	15.8	0.035	3	1:1	95.14	95.20	3.8	25.8	-	0.00010	0.65	0.65	16.8	0.48
	6+00	7+55	0.26	15.8	0.035	3	1:1	95.20	95.22	3.3	20.8	-	0.00016	0.76	0.76	15.8	0.12
	7+55	7+85	0.26	15.8	Bridge								*0.00500				0.02
	7+85	12+00	0.26	15.8	0.035	3	1:1	95.22	95.30	3.3	20.8	-	0.00016	0.76	0.76	15.8	0.31
	12+00	15+50	0.26	15.8	0.035	3	1:1	95.30	95.39	3.0	18.0	-	0.00025	0.91	0.91	16.4	0.36
	15+50	20+00	0.26	15.8	0.035	3	1:1	95.39	95.65	2.4	13.0	-	0.00058	1.22	1.22	15.8	0.46
	20+00	26+00	0.26	15.8	0.035	3	1:1	95.65	96.73	1.8	8.6	-	0.00180	1.88	1.88	16.2	0.58
	26+00	28+50	0.26	15.8	0.035	3	1:1	96.73	97.56	1.5	6.8	-	0.00330	2.34	2.34	15.9	0.24
	28+50	39+50	0.26	15.8	0.035	3	1:1	97.56	102.29	1.4	6.2	-	0.00430	2.58	2.58	16.0	1.23
Lat. #2	1+80	6+45	0.70	44.5	0.035	3	1:1	95.38	95.65	4.0	28.0	-	0.00058	1.60	1.60	44.8	0.52
	6+45	6+75	0.70	44.5	Culvert								*0.22000				0.03
	6+75	12+00	0.70	44.5	0.035	3	1:1	95.87	96.14	4.1	29.1	-	0.00052	1.54	1.54	44.8	0.58
	12+00	18+00	0.70	44.5	0.035	3	1:1	96.14	96.50	3.9	27.9	-	0.00060	1.61	1.61	44.9	0.69
	18+00	23+60	0.70	44.5	0.035	3	1:1	96.50	96.95	3.7	24.8	-	0.00080	1.80	1.80	44.6	0.64
	23+60	28+00	0.31	19.6	0.035	3	1:1	96.95	97.13	3.0	18.0	-	0.00040	1.14	1.14	20.5	0.51
	28+00	32+00	0.31	19.6	0.035	3	1:1	97.13	97.85	2.0	10.0	-	0.00180	1.99	1.99	19.9	0.48
	32+00	36+90	0.31	19.6	0.035	3	1:1	97.85	99.57	1.7	8.0	-	0.00350	2.56	2.56	20.5	0.62
	36+90	37+90	0.31	19.6	0.035	3	1:1	99.57	99.97	1.6	7.4	-	0.00400	2.65	2.65	19.6	0.13
	37+90	51+40	0.31	19.6	0.035	3	1:1	99.97	106.72	1.5	6.8	-	0.00500	2.88	2.88	19.6	1.82

(continued)

TABLE 3A - STRUCTURE DATA (cont'd.)
CHANNEL IMPROVEMENT
(Agri. Channels)

Assunpink Creek Watershed, New Jersey

Channel Designation	Station Numbering For Reach		Watershed Area (sq. mi.)	6/ Required Capacity (cfs)	Manning's "n" Value Design	Channel Design		Design Water Surface Elev. (MSL Datum)		3/ Design Depth (ft)	Flow Area At Design Depth (sq ft)		Planned Hyd. Gradient (ft/ft)	Channel Velocity		Planned Cap. At Design Depth (cfs)	Vol. of Excav. (1000 cu yd)
	Station	Station				Bot. Width (ft)	Side Slopes	Foot	Head		Channel	Floodplain		Design Depth ft/sec	5-Yr. Freq. ft/sec		
Lat. #3	0+00	4+55	1.79[1]	13.8[2]	0.035	3.0	1:1	96.03	96.07	3.5	22.8	-	0.00009	0.61	0.61	13.8	0.40
	4+55	4+85	1.79[1]	13.8[2]	Bridge								*0.00300				0.02
	4+85	6+00	1.79[1]	13.8[2]	0.035	3.0	1:1	96.07	96.08	3.5	22.8	-	0.00009	0.61	0.61	13.8	0.09
	6+00	12+00	1.79[1]	13.8[2]	0.035	3.0	1:1	96.08	96.35	2.4	13.0	-	0.00045	1.08	1.08	14.0	0.48
	12+00	16+00	1.79[1]	13.8[2]	0.035	3.0	1:1	96.35	96.79	1.9	9.3	-	0.00110	1.52	1.52	14.1	0.22
	16+00	21+50	1.79[1]	13.8[2]	0.035	3.0	1:1	96.79	97.89	1.6	7.4	-	0.00200	1.87	1.87	13.8	0.31
	21+50	23+50	1.79[1]	13.8[2]	0.035	3.0	1:1	97.89	98.39	1.5	6.8	-	0.00250	2.04	2.04	13.9	0.11
	23+50	34+50	1.79[1]	13.8[2]	0.035	3.0	1:1	98.39	102.24	1.4	6.2	-	0.00350	2.32	2.32	14.4	0.62
Lat. #4	0+00	21+05	0.80	47.9	0.035	3.0	1:1	97.08	98.51	4.0	28.0	-	0.00068	1.73	1.73	48.4	2.08
	21+05	21+35	0.80	47.9	Bridge								*0.02000				0.03
	21+35	22+00	0.80	47.9	0.035	3.0	1:1	98.53	98.54	4.0	28.0	-	0.00068	1.73	1.73	48.4	0.07
	22+00	26+00	0.80	47.9	0.035	3.0	1:1	98.54	98.95	3.6	23.8	-	0.00103	2.02	2.02	48.1	0.38
	26+00	30+00	0.80	47.9	0.035	3.0	1:1	98.95	99.71	3.1	18.9	-	0.00190	2.54	2.54	48.0	0.38
	30+00	42+60	0.80	47.9	0.035	3.0	1:1	99.71	103.36	2.8	16.2	-	0.00290	2.98	2.98	48.3	2.59
Lat. #5	0+00	4+00	0.072	5.3	0.035	3.0	1:1	98.10	98.20	1.7	8.0	-	0.00025	0.68	0.68	5.4	0.21
	4+00	6+20	0.072	5.3	0.035	3.0	1:1	98.20	98.40	1.2	5.0	-	0.00090	1.09	1.09	5.5	0.11
	6+20	10+30	0.072	5.3	0.035	3.0	1:1	98.40	99.06	1.0	4.0	-	0.00160	1.33	1.33	5.3	0.22
Lat. #6	0+00	4+00	0.072	5.3	0.035	3.0	1:1	100.83	101.03	1.4	6.2	-	0.00050	0.88	0.88	5.5	0.49
	4+00	5+00	0.072	5.3	0.035	3.0	1:1	101.03	101.28	0.9	3.5	-	0.00250	1.58	1.58	5.5	0.12
Bridegroom Run	0+00	5+00	1.68	96.5	0.035	6.0	1:1	69.95	71.05	2.3	15.5	142.2	0.00220	3.35	3.35	98.8	0.22
	5+00	15+00	1.68	96.5	0.035	6.0	1:1	71.05	72.45	2.4	18.2	131.4	0.00140	2.56	2.56	99.2	0.44
	15+00	15+40	1.58	90.4	Bridge								*0.06000				0.02
	15+40	37+40	1.58	90.4	0.035	5.0	1:1	72.51	75.59	2.4	15.8	132.8	0.00140	2.55	2.55	92.9	0.82
	37+40	43+30	1.58	90.4	0.035	5.8	2:1	75.59	76.77	2.6	27.7	14.4	0.00200	2.92	2.92	91.6	0.00[5]
	43+30	43+70	0.89	50.7	Bridge								*0.08000				0.00[5]
	43+70	47+70	0.89	50.7	0.035	4.0	2:1	76.85	77.25	2.7	27.9	-	0.00101	1.82	1.82	50.8	0.00[5]
	47+70	50+80	0.89	50.7	0.035	2.4	2:1	77.25	77.64	2.7	26.6	-	0.00125	1.92	1.92	51.1	0.00[5]
	50+80	62+50	0.89	50.7	0.035	5.0	1:1	77.64	79.63	2.7	20.8	-	0.00170	2.44	2.44	50.8	1.51

(continued)

TABLE 3A - STRUCTURE DATA (cont'd.)
CHANNEL IMPROVEMENT
(Agri. Channels)

Assunpink Creek Watershed, New Jersey

Channel Designation	Station Numbering For Reach		Watershed Area (sq. mi.)	6/ Required Capacity (cfs)	Manning's "n" Value Design	Channel Design		Design Water Surface Elev. (MSL Datum)		3/ Design Depth (ft)	Flow Area At Design Depth (sq ft)		Planned Hyd. Gradient (ft/ft)	Channel Velocity		Planned Cap. At Design Depth (cfs)	Vol. of Excav. (1000 cu yd)
	Station	Station				Bot. Width (ft)	Side Slopes	Foot	Head		Channel	Floodplain		Design Depth ft/sec	5-Yr. Freq. ft/sec		
Bridegroom Run	62+50	66+80	0.89	50.7	0.035	5	1:1	79.63	80.62	2.5	18.8	-	0.00230	2.73	2.73	51.3	0.71
	66+80	71+00	0.89	50.7	0.035	5	1:1	80.62	81.80	2.4	17.8	-	0.00280	2.96	2.96	52.7	0.81
	71+00	73+50	0.56	32.0	0.035	5	1:1	81.80	82.33	2.0	14.0	-	0.00210	2.33	2.33	32.6	0.47
	73+50	83+20	0.56	32.0	0.035	5	1:1	82.33	87.18	1.6	10.6	-	0.00500	3.22	3.22	34.1	1.76
	83+20	102+45	0.56	32.0	0.035	5	1:1	87.18	92.57	1.9	13.1	-	0.00280	2.62	2.62	34.3	2.46
	102+45	102+75	0.15	11.0 4/	Culvert								*0.12000				0.03
	102+75	106+60	0.15	11.0 4/	0.035	3	1:1	92.69	93.23	1.6	7.4	-	0.00140	1.57	1.57	11.6	0.42
	106+60	108+80	0.15	11.0 4/	0.035	3	1:1	93.23	93.85	1.3	5.6	-	0.00280	2.00	2.00	11.2	0.25
	108+80	120+50	0.15	11.0 4/	0.035	3	1:1	93.85	101.22	1.1	4.5	-	0.00630	2.76	2.76	12.4	1.56
Hancock Creek	0+00	14+50	0.52	36.6	0.035	3	1:1	87.10	91.52	2.4	13.0	-	0.00305	2.82	2.82	36.7	0.60
	14+50	14+70	0.52	36.6	Culvert								*1.30000				0.01
	14+70	18+80	0.52	36.6	0.035	3	1:1	92.82	93.27	3.1	18.9	-	0.00110	1.94	1.94	36.7	0.16
	18+80	23+50	0.52	36.6	0.035	3	1:1	93.27	94.31	2.6	14.6	-	0.00222	2.51	2.51	36.6	0.19
	23+50	42+10	0.52	36.6	0.035	3	1:1	94.31	99.98	2.4	13.0	-	0.00305	2.82	2.82	36.7	1.83

*Headloss

July, 1964

1/ Includes 1.68 square miles controlled by Site #15
2/ Includes 8.4 cfs release rate from Site #15
3/ Average depth of flow in reach
4/ Based on "C" drainage curve
5/ Existing channel is adequate
6/ 5 year frequency - 24 hour duration average discharge

TABLE 3A - STRUCTURE DATA
CHANNEL IMPROVEMENT
(Pond Run Channels)

Assunpink Creek Watershed, New Jersey

Station 2/	Watershed Area (sq mi)	Required Capacity 3/ (cfs)	Manning's "n" Value Design	Channel Design: Bottom Width (ft)	Channel Design: Side Slopes	Design Water Surface Elev. (msl)	Design Depth (ft)	Flow Area At Design Depth (sq ft): Channel	Flow Area At Design Depth (sq ft): Floodplain	Planned Hydraulic Gradient (ft/ft)	Channel Velocity: Design Depth ft/sec	Planned Capacity At Design Depth (cfs)	Volume Of Excav. (1000 cu yd)	Volume Of Concrete (cu yd)
4+80	10.10	1310				38.39 1/						1310		
			0.012	2-8.5' ϕ Concrete Culverts + Existing Structure						0.001300			-	-
6+40	10.10	1310		50	Vert.	38.60	7.00	126.0	-		10.40	1310		
			0.013	Transition						0.000125			3.02	140
7+20	10.10	1310		18	Vert.	38.67	6.91	124.4	-		10.53	1310		
			0.013										11.18	710
13+13	10.10	1310		18	Vert.	39.43	6.96	125.3	-	0.001380	10.45	1310		
			0.013										5.09	710
19+06	10.10	1310		18	Vert.	40.21	6.97	125.5	-	0.001320	10.44	1310		
			0.013										5.01	652
24+99	10.10	1310		18	Vert.	40.98	6.97	125.5	-	0.001300	10.44	1310		
			0.013										28.71	4,278
64+00	10.10	1310		18	Vert.	46.05	6.97	125.5	-	0.001300	10.44	1310		
			0.013										4.44	670
69+93	8.88	1087		18	Vert.	46.50	6.65	119.7	-	0.000758	9.08	1087		
			0.013										4.47	670
75+86	8.88	1087		18	Vert.	47.06	6.44	115.9	-	0.000944	9.38	1087		
			0.013										4.55	670
81+79	8.88	1087		18	Vert.	47.70	6.31	113.6	-	0.001079	9.57	1087		
			0.013										4.55	670
87+72	8.88	1087		18	Vert.	48.40	6.24	112.3	-	0.001180	9.68	1087		
			0.013										2.28	382
93+65	8.88	1087		18	Vert.	49.12	6.19	111.4	-	0.001214	9.76	1087		
			0.013										4.17	670
99+58	8.88	1087		18	Vert.	49.88	6.18	111.2	-	0.001281	9.78	1087		
			0.013										4.01	646
106+00	8.88	1087		18	Vert.	50.71	6.18	111.2	-	0.001292	9.78	1087		
			0.030	Transition From Concrete to Earth Channel									2.13	-
109+33	5.65	495		24	2:1	50.80	5.90	211.2	-	0.000270	2.34	495		
			0.030										2.13	-

(continued)

TABLE 3A - STRUCTURE DATA (cont'd.)
CHANNEL IMPROVEMENT
(Pond Run Channels)

Assunpink Creek Watershed, New Jersey

Station 2/	Watershed Area (sq mi)	Required Capacity 3/ (cfs)	Manning's "n" Value Design	Channel Design: Bottom Width (ft)	Channel Design: Side Slopes	Design Water Surface Elev. (msl)	Design Depth (ft)	Flow Area At Design Depth (sq ft): Channel	Flow Area At Design Depth (sq ft): Floodplain	Planned Hydraulic Gradient (ft/ft)	Channel Velocity Design Depth ft/sec	Planned Capacity At Design Depth (cfs)	Volume Of Excav. (1000 cu yd)	Volume Of Concrete (cu yd)
112+66	5.65	495	0.030	24	2:1	50.91	5.64	197.9	-	0.000330	2.50	495	1.85	-
115+99	5.65	495	0.030	24	2:1	51.05	5.41	188.4	-	0.000420	2.63	495	1.18	-
119+32	5.65	495	0.030	24	2:1	51.21	5.20	178.9	-	0.000480	2.77	495	1.18	-
122+65	5.65	495	0.030	24	2:1	51.40	5.02	170.9	-	0.000570	2.90	495	1.18	-
125+98	5.65	495	0.030	24	2:1	51.60	4.85	163.4	-	0.000600	3.03	495	1.18	-
129+31	5.65	495		24	2:1	51.83	4.71	157.4	-	0.000690	3.14	495		

July, 1964

Note: All bridges are integral parts of the channel and all losses are minor, other than the friction loss.

1/ Backwater from Assunpink Creek. An earth channel with a 50 ft. B.W. and 2:1 side slopes will be dug for a distance of 250 ft. downstream from the Pennsylvania Railroad to provide outlet for the culverts.
2/ Station number at upper end of the channel reach is the design point for the reach.
3/ 100 year frequency - 12 hour duration peak discharge.

TABLE 4 - ANNUAL COST

Assunpink Creek Watershed, New Jersey

Dollars [1/]

EVALUATION UNIT	AMORTIZATION OF INSTALLATION COSTS	OPERATION AND MAINTENANCE COST	TOTAL
ASSUNPINK - Reach "A" [2/] (Floodwater Retarding Structures 7, 7A, 15 and 21 and Multipurpose Structures 4, 5, 6, 18, 19 and 20)	151,025	68,703	219,728
POND RUN - Reach "B" [2/] (Stream Channel Improvement and Floodwater Retarding Structure 8)	74,377	985	75,362
NEW SHARON BRANCH [3/] (Stream Channel Improvement)	4,372	1,296	5,668
BRIDEGROOM RUN [3/] (Stream Channel Improvement)	838	235	1,073
HANCOCK CREEK [3/] (Stream Channel Improvement)	236	53	289
TOTAL	230,848	71,272	302,120

July, 1964

1/ Price Base 1964
2/ Amortized @ 3% for 100 years
3/ Amortized @ 3% for 50 years

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Assunpink Creek Watershed, New Jersey

Dollars [1/]

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Non-Agricultural			
Commercial	1,779	-	1,779
Industrial	115,295	174	115,121
Residential	67,940	-	67,940
Indirect	31,177	26	31,151
TOTAL	216,191	200 [2/]	215,991

July, 1964

1/ Price Base - Long Term as projected in ARS September, 1957 Price Projections.
2/ Damages will be greater than this in storms of greater than the 100 year frequency event.

TABLE 6 - COMPARISON OF BENEFITS & COSTS FOR STRUCTURAL MEASURES

Assunpink Creek Watershed, New Jersey

(Dollars) [1/]

Evaluation Unit	AVERAGE ANNUAL BENEFITS								Average Annual Cost	Benefit Cost Ratio
	Flood Prevention			Agricultural Water Management	Non-Agricultural Water Management		Secondary	Totals		
	Damage Reduction	More Intensive Land Use	Changed Land Use (Urban)	Drainage	Fish & Wildlife	Recreation				
ASSUNPINK - Reach "A" (Floodwater Retarding Structures 7, 7A, 15 & 21 & Multipurpose structures 4, 5, 6, 18, 19 & 20)	131,381				22,965	390,000	11,424	555,770	219,728	2.6:1
POND RUN - Reach "B" (Stream Channel improvement and Floodwater Retarding Structure 8)	80,315		1,161			3,000 [2/]	6,809	91,285	75,362	1.2:1
NEW SHARON BRANCH (Stream Channel Improvement)		11,212		6,169			2,072	19,453	5,668	3.4:1
BRIDEGROOM RUN (Stream Channel Improvement)		6,013		6,014			1,409	13,436	1,073	12.5:1
HANCOCK CREEK (Stream Channel Improvement)		2,871		2,872			675	6,418	289	22.2:1
GRAND TOTAL	211,696	20,096	1,161	15,055	22,965	393,000	22,389	686,362 [3/]	302,120	2.3:1

July, 1964

1/ Price Base 1964
2/ Incidental Recreational Benefits for Site 8 which is a single purpose floodwater retarding structure.
3/ In addition it is estimated that land treatment measures will provide flood damage reduction of $4,692 annually.

INVESTIGATIONS AND ANALYSIS

HYDROLOGY AND HYDRAULICS INVESTIGATIONS

Assunpink Creek

Annual flood peaks and their associated runoff were obtained from USGS stream gage data for the period 1924-1958. The stream gage is located a short distance downstream from the beginning of damage reach A on the main stem. A discharge-frequency curve of annual peaks was plotted using the "Computing Method" described in the SCS National Engineering Handbook, Hydrology, Section 4.

A peak discharge-runoff curve was plotted. Using this curve and the 100-year frequency discharge of 3,650 cfs taken from the discharge-frequency curve, a 100-year runoff of 2.9 inches was obtained.

Simple triangular hydrographs for each sub-watershed were prepared using the formulae:

$$q = \frac{484\ QA}{Tp} \quad ; \quad Tp = \frac{D}{2} + 0.6\ Tc \quad ; \quad Tb = 2.67\ Tp$$

Where: q = Peak Discharge (cfs), Q = Runoff (inches), A = Drainage Area (square miles), Tp = Time to Peak (hours), D = Duration (hours), Tc = Time of Concentration (hours), Tb = Time to Base (hours).

A uniform Q of 2.9 inches for the 100-year frequency event and 1.9 inches for the 10-year frequency event were then routed to the stream gage using Wilson's Method. After several trials using different durations the 100-year frequency and 10-year frequency storms were duplicated. A 44-hour duration storm was used.

The 100-year frequency storm with the ten structures in place was routed to the stream gage using Wilson's Method in channel routing and the storage-indication procedure through the structures. The 10-year frequency discharge with the ten structures in operation was developed by using a simplified procedure for routing. The discharge-frequency curves for present and future conditions were then plotted using the values from the routings.

Minimum storage requirements for all reservoir sites were determined by the procedure outlined in Soil Conservation Service Technical Release No. 10. The 100-year frequency precipitation used in this procedure was obtained from U. S. Weather Bureau Technical Paper No. 29. Runoff rates were determined according to the weighted soil-cover complex numbers which were computed by using Table 3.9-1 in the SCS National Engineering Handbook, Hydrology, Section 4. Data to compute soil-cover complex numbers was furnished by the Mercer and Monmouth County Work Unit Conservationists and the U. S. Forest Service.

All principal spillways are of the two stage type. Sites 6, 20 and 21 are straight drop structures. Each of the remaining sites has

a concrete riser and pipe. The crest elevation of the low stage was determined by the sediment storage requirement. The first stage average release rate is 5 csm. The second stage crest elevation was based on the volume of storage required to lag the second stage release rate behind the peak flow for the design storm. Several trials were made to get maximum reduction of damages.

The hazard classification of the sites is based on criteria in Washington Engineering Memorandum SCS-27. Sites 7, 8, 20 and 21 are class "c", and the remaining sites are class "b". Site 7A was designed for greater than the minimum class "b" criteria.

Emergency spillway and freeboard designs were determined from hydrographs produced by rainfalls taken from hydrologic maps based on U. S. Weather Bureau Technical Paper No. 40. The storage-indication procedure was used for routing through the structures. Procedures outlined in Washington Engineering Memorandum SCS-43 (Structures in Series) were adhered to in Sites 4 and 7A. For Sites 6 and 20, the local inflow was used. In final design SCS-43 will be used for all structures in series.

Stage-discharge relationships in Trenton were established by preparing water surface profiles. The IBM 650 computer was used in accordance with SCS Technical Release 14. Water surface profiles were run for 11 different rates starting at the stream gage, going through the damage reaches, and ending at Whitehead Mill Dam.

The stage-discharge relationships and the discharge-frequency curves were used in the economic analysis.

Pond Run

Simple triangular hydrographs for the 100-year and 10-year frequency 12-hour duration storms were prepared for the subwatersheds and routed through the damage reaches using Wilson's Method. Discharge-frequency curves for present conditions were plotted for each damage reach.

Stage-discharge relationships for the damage reaches were established by water surface profiles, using the step method outlined in National Engineering Handbook, Hydrology, Section 4.

A 12-hour duration 100-year frequency hydrograph was routed through Site 8 using the storage-indication procedure. Routing was then continued through the damage reaches using Wilson's Method. The 100-year frequency discharge was used in dimensioning the culverts under the Pennsylvania Railroad; the concrete channel from the Pennsylvania Railroad to the confluence with the North Branch of Pond Run; and the earth channel from the confluence to station 129+30.

An investigation was made for the area between the end of the proposed channel work and reservoir Site 8. Water surface profiles for the 100-year frequency and the 10-year frequency events were calculated by using the Step Method. This investigation was made to

determine the extent of the flooding with the project installed for guidance in future land use planning. Refer to map on page 65 showing area still subject to flooding.

New Sharon Branch, Hancock Creek and Bridegroom Run

The channel capacities were based on the 5-year 24-hour volume of runoff or the "C" drainage curve, whichever was greater. The 5-year 24-hour rainfall was obtained from U. S. Weather Bureau Technical Paper No. 40. The associated runoff was determined by using procedures outlined in Chapter 3.9 (Hydrologic Soil-Cover Complexes) of the National Engineering Handbook, Hydrology, Section 4, Supplement A. The 5-year 24-hour volume of runoff was used in all cases except for the last 1,800 feet of Bridegroom Run, where the "C" drainage curve was used. In most instances the 5-year 24-hour volume of runoff was equivalent to "B" curve or better drainage.

Manning's Open Channel Formula was used to establish the water surface profiles.

ENGINEERING INVESTIGATIONS

Flood Control Structures

All preliminary designs are in accord with Soil Conservation Service criteria. Stage storage curves for the sites were based on two foot contour interval topographic maps. Semi-controlled aerial mosaics were used as base maps for sites numbered 4, 5, 6, 7, 8, 15, 18, 20 and 21. Bench level circuits (mean sea level) were run to each site for vertical control. Valley cross-sections were surveyed and plotted directly on the aerial photographs. The contour lines were sketched on the photographs in the field using the plotted data and visual observations. Topographic maps for sites 7A and 19 were made from stadia surveys which were tied into mean sea level datum.

Sediment storage for the sites is based on the expected accumulation over a 100 year period. In determining size of recreation pools, consideration was given to topography and locations of highways and buildings. Flood storage and the principal spillway release rates were designed to control a 100-year frequency storm. The heights of the dams were established by routing the freeboard hydrographs.

Earth fill volumes were computed by using the average end area method.

Stream Channel Improvement

Pond Run

Bench level surveys, based on mean sea level datum, were run in the vicinity of the proposed works of improvements. Permanent bench marks were established. Aerial photographs (scale 1" = 660') were used for horizontal control. Cross-sections were taken at approximately 1,500 foot intervals along the 2.4 miles of the proposed stream

channel improvement. Centerline points of each section were plotted. The resulting stream channel profile was used in preparing the designs.

The designed channel will have a reinforced concrete section from Station 6+40 to Station 106+00. A gravel filter 2 feet thick and 6 inch perforated corrugated metal pipe relief drains will be placed under the structure in order to relieve the uplift pressures. All the existing bridges have adequate capacity and will be made an integral part of the concrete lined channel with the exception of the culvert under the Pennsylvania Railroad. Two 8.5 foot culverts will be jacked or tunneled through the railroad fill to supplement the existing structure. The 250 feet from the railroad culverts to Assunpink Creek will be earth channel. From Station 106+00 to the upper limit of the construction at Station 129+30 the channel will be cut in earth.

Additional valley cross sections were taken in the area between the constructed earth channel and Reservoir Site 8. These sections were spaced approximately 1,600 feet apart and were used to calculate the elevations of the 100-year and the 10-year frequency storms at the various sections. These elevations were plotted on an aerial photograph (scale 1" = 660') and the two flood lines were delineated.

The volume of concrete in the lined channel was computed by calculating the end area of the concrete section for each reach and multiplying this figure by the scaled length. The channel excavation, structural backfill, and filter material were computed by plotting the design section on the surveyed stream channel cross-section and planimetering the area to be excavated, backfilled, or filled with filter material. These areas were multiplied by the scaled length of reach to determine the estimated quantities.

A detailed stream channel survey will be made prior to the final design of the channels.

Agricultural Channels

Permanent bench marks, based on mean sea level datum, were established in the vicinities of proposed stream channel improvements. Aerial photographs (1" = 660' and 1" = 1667') were used for horizontal control. Cross-sections were taken approximately 1,500 feet apart. Stream channel profiles were developed by plotting centerline elevations of each cross section along with intermediate channel elevations. Spot elevations were taken in the fields adjacent to the stream channels in order to determine the control points for drainage.

The volume of channel excavation was computed by plotting the design section on the surveyed stream channel cross-section and planimetering the area to be excavated. This area was multiplied by the scaled length of reach to determine the estimated quantity of earthwork. The total earthwork quantity includes one foot of overdigging. The materials that are being excavated are poorly graded sands so the channels are being overdug to insure design capacity following the initial period of the side slope stabilization. To control entrance of surface water into the channels with a minimum of erosion, pipe

outlets will be installed at the upper limits of construction on New Sharon Branch and all laterals except numbers 2 and 3.

Detailed stream channel surveys will be made prior to the final design.

GEOLOGIC INVESTIGATIONS

Floodwater Retarding and Multipurpose Sites

Sites 4 and 5 are underlain by Englishtown sand to a depth of 50 to 100 feet. The floodplain is underlain by more recent poorly graded sands and gravels of the Cape May formation. A thin alluvium is found above that.

Hand auger borings and probings indicate a rapidly permeable, poorly graded sand with some silt on both abutments. The valley floor is covered by 2-6 feet of dark silty alluvium with some organic matter. Beneath this was found porous, saturated, poorly graded sands and fine gravels. No further penetration could be made below 6-9 feet. This was apparently due to gravel estimated to be 20-50 feet thick. The investigations of the abutments indicated that no special problems exist for the emergency spillway.

Adequate borrow material consisting of silty sands and sandy silts is found within a very short distance of the site. Seepage and pervious conditions throughout the site will be considered during the final design.

Site 6 is underlain at 20-30 feet by the Merchantville micaceous silty clay. However, this is capped by the more recent (interglacial) yellow silty gravels and sand of the Pennsauken formation and in the stream valley itself by post-glacial sands and fine gravels of the Cape May formation. More recent sandy silt alluvium was deposited in the floodplain. In the early 1900's a dam located a short distance downstream inundated this area for use as a mill pond or ice pond. Consequently, very recent silty alluvium is located on the surface of the floodplain presumably deposited on the lake bottom behind the old dam.

Hand borings and probings indicated 2-3 feet of sandy silt with some clay on the abutments. Beneath this, to a depth of 4 feet, pervious silty sand and gravel were found. In the valley floor 2-4 feet of recent silty alluvium with some organic matter was found to overlie firm silty sand alluvium to a depth of 5-8 feet. Beneath this lie the post-glacial porous sands and gravels which filled the valley to a depth of 10-20 feet.

Buried channels were located in the floodplain. No problem is anticipated in constructing the emergency spillway in either abutment. The porous abutments and deep strata of the valley floor are special problems. The silty alluvium should provide a reasonably impervious bed for the impoundment if compacted. No positive cutoff is anticipated at this site.

The borrow materials for the embankment can be found close to the site. They are sandy silts and silty sands.

Site 7 is located near Lawrenceville in the massive argillite of the Triassic Lockatong formation. The abutments are generally shallow to hard rock and there is a maximum of 3 feet of shaly or flaggy, gravelly silt in the valley floor. No buried channels are likely. Bedrock in the valley floor seems to have open joints, but they are tight in a nearby quarry. No foundation stability problems are likely.

Rock excavation in the emergency spillway will probably be needed.

Suitable borrow is available from the terrace and valley floor.

Site 7A is also located near Lawrenceville on the boundary between the Triassic Piedmont and the Coastal Plain.

The abutments are moderately pervious silty sands and gravels, but the valley floor is slowly permeable, low plasticity clay with silt. Buried stream channels may exist. Some shallow drilling may be needed to provide adequate knowledge of foundation conditions. The emergency spillway will probably not require rock excavation.

The bottom will provide considerable borrow for the core of the dam. Care should be taken not to expose pervious strata. Good borrow is found close to the site, being silty gravel with a little clay.

Sites 8 and 21 are underlain at 20-50 feet by the stratified clays and fine sands of the Magothy-Raritan formation. Above this lies the yellow silty sands and gravels of the interglacial Pennsauken formation. In the valley floor a late valley fill of 5-10 feet of poorly graded sands and gravels of Cape May formation are found. This is finally topped by 1-6 feet of very recent silty alluvium.

Hand augering, probings and pit excavations on the abutments have disclosed silty sands, sandy silts and gravels with little likelihood of foundation problems. The valley floor is underlain by deep pervious sands and gravels and should not cause foundation problems. Seepage is a problem, but compacting existing silty alluvium and blanketing porous areas should do. Provision should be made for some drilling to establish anticipated stratigraphy. No problems are anticipated in the emergency spillway area.

Good borrow material consisting of silty sand and gravel is readily available near the sites.

Site 15 is underlain by 20-30 feet of the Mount Laurel and Wenona sands on the abutments. However, in the valley floor the very firm, micaceous dark silt of the Marshalltown formation extends 40-50 feet in depth. Some silty sands and gravels of more recent deposition are found in the valley floor above the micaceous silt. This in turn is topped by dark brown silty alluvium.

Hand augering and probing established the presence of stable, but porous, silty, poorly graded sands on the abutments. In the valley floor as much as 6-8 feet of the recent silty alluvium is found above coarser, porous material. This silty alluvium is highly compressible, but very firm, black micaceous silts beneath are very stable and impermeable. There are no problems anticipated in building the emergency spillway.

Borrow areas close to the site provide sandy silts and silty sands with some fine gravel.

Site 18 is located near Roosevelt on the Red Bank silty sands. In the valley floor deep muck deposits have accumulated.

It was determined by hand augering that the silty sands and sandy silts were found on both abutments and stable, though pervious, foundations exist. In the valley floor, however, 2-10 feet of highly organic silt was found along the centerline of the dam. This is highly compressible. However, it provides a good seal over pervious bottom sands. The emergency spillway location poses no problems in excavation. Erosion of the channel may be a problem.

Borrow materials are available close at hand, mainly silty sands and sandy silts. Some ironstone suitable for rip rap may be found.

Site 19 is quite similar to Site 18, except that the bottom is more glauconetic sandy silty or clayey silt. Hand augering indicated that the depths of the highly organic, plastic silt reaches 12-14 feet in places. This provides a highly compressible foundation and probably should be removed from under the dam, but will provide a slowly permeable blanket over the pool area. No excavation problems are anticipated for the emergency spillway.

Borrow is readily available close to the site. It is sandy silt and silty sand. Considerable ironstone might be recovered for rip rap if needed.

Site 20 is underlain by deep yellow sandy silts and gravels of the Pennsauken formation. A valley fill of poorly graded gravel and sand is found on top of that, and recent alluvial deposits of sand and silt at the surface of the floodplain.

Hand augering and probing revealed that recent deposits of alluvial silt ranging from 2-6 feet in depth cover 2-4 feet of alluvial sands in the floodplain. The abutments are sandy silts and offer no foundation or emergency problems. The foundation is very porous, but a thin silt blanket exists which should reduce leakage. Care should be taken in final design to seal the dam.

Borrow material consisting of silty sand and gravel is available close to the site.

Stream Channel Improvement

New Sharon Branch

Soil borings were made with a hand auger at approximately 1,500 foot intervals along the main channel. From Station 22+15 to 128+90 the soils are poorly graded sands and gravel covered with recent alluvial silt deposits ranging from 1.5 - 3.5 feet in depth. The remaining portion of the main channel consists of sandy silts and silty sands.

Hand auger borings were made at 850 foot intervals on lateral No. 4. The soil was found to be micaceous silt covered by more recent deposits of silty sand and gravel. This in turn is topped by dark gray silty alluvium.

Two hand auger borings made along lateral No. 2 were spaced about 1,800 feet apart. The soils ranged from fine silt to silt loam.

The borings made for lateral No. 1 were spaced at 1,300 foot intervals. The lower reach consists of poorly graded sand covered with up to 5.5 feet of organic silt. The soils in the upper reach are poorly graded sands.

Laterals No. 5 and No. 6 are very short. Soil information obtained at their point of entry into the main channel was used in the designs.

Soil borings made along the main channel were used for Lateral No. 3 for the area close to the confluence. These soils consist of poorly graded sands covered with silty alluvium to a depth of 1-2 feet. The soils several hundred feet each side of the abandoned trolley line contain alternating lenses of sandy silt and organic silt to a depth of 5.5 feet. The underlying material is a poorly graded sand. The remainder of the proposed channel has soils which are micaceous silts covered with more recent deposits of sandy silts and gravels, which in turn are covered by dark brown silty alluvium.

Bridegroom Run

Hand auger borings were made at 1,800 foot intervals along Bridegroom Run. The soils in the lower reach consist of 2-2.5 feet of silt over a 1 foot thick layer of sand and gravel. The underlying material is a fine silt. The soils in the upper reach consist of 2 feet of silt. No further penetration could be made because of coarse sand and gravel.

Hancock Creek

Two hand auger borings were made along the proposed 4,200 feet of channel improvement. The soils consist of 2-2.5 feet of silts and sandy silts over very deep poorly graded sands.

Pond Run

This area is highly industrialized and urbanized. Both existing channel banks have been walled and filled in behind the walls. The fill consists of cinders, gravel, and other coarse material that could not be penetrated with a hand auger. Only 3 areas were investigated. A boring was made at Station 80+00. The soils were found to be poorly graded sands and silty sands with a 1.5 foot deposit of dark brown silt. At Station 104+00 the soils were poorly graded sands and silty sand with a 3.5 foot layer of silt on the surface. The soils at Station 122+00 were found to be similar to the other two. There was a 1.0 foot layer of silt over poorly graded sands and silty sands.

A detailed investigation will be made along the Pond Run proposed channel prior to final design.

Consideration will be given to the possibility of raising the design water surface elevation shown in Table 3A not to exceed three feet at the Johnston Avenue bridge (station 22+80), if detailed geologic investigations indicate this is needed to achieve project objectives at the least cost. Appropriate adjustments in the design water surface elevations, channel bottom elevations, channel dimensions, and judicious use of excavated spoil also will be made to blend the adjusted water surface elevation into the design water surface elevation shown in Table 3A at Kuser Road (station 106+00).

All hand auger borings were made to a depth of 7-8 feet except where conditions prevented penetration to that depth.

Sediment Analysis

In determining sediment storage requirements for the 11 reservoir structures, 3 representative sites -- 5, 7 and 19 -- were analyzed by use of Musgrave's Soil Loss Formula. Soil losses from the remaining sites were then estimated by comparison of characteristics with those on the 3 measured sites. Soil losses were calculated for a 100 year period.

Consideration was given to the expected rapid urban expansion affecting sites 7, 7A, 8 and 21 in Mercer County. County and township planning boards provided forecasts of urban trends by location, size of lots, and schedule of construction. Local real estate and architect agencies provided information on size of dwelling units and areas of streets, walks and driveways in relation to lot sizes.

The above information was used to calculate changes in soil loss during construction and after completion of construction, and then incorporated into the total soil loss for the evaluation period.

Sediment delivery rates were based on reservoir sedimentation studies summarized in the Geology Section of the Watershed Planning Guide, and modified on the basis of local characteristics.

Trap efficiencies were computed by use of the procedure outlined

in the Geology Section of the Watershed Planning Guide.

Reservoir sediment storage requirements were calculated from soil loss, delivery rate and trap efficiency data.

ECONOMIC INVESTIGATIONS

The basic information for urban residential, commercial and industrial damages on Assunpink Creek and its tributary, Pond Run, was obtained in the field. Through personal interviews with property owners, businessmen, industrial plant engineers and accountants, damage schedules were developed. As a part of the basis for preparation of damage schedules a physical examination of each of the industrial plants and the commercial properties was made in conjunction with the property managers. Damage estimates were developed for the 100-year stage based on the hydrologic computation in each damage reach. Damage estimates were developed one foot above this stage and at one foot stages below to the elevation of zero damages. These damage estimates were developed separately for each major plant and for about 85 percent of the commercial establishments. Damage estimates and schedules were developed for about 25 percent of the residences and these rates applied to the total property effected at each stage. Twelve reaches on the Assunpink and ten on Pond Run were used for evaluation. Damage estimates in each reach were summarized by stages and correlated with the hydrologic data to prepare stage-damage and damage-frequency curves. Damage estimates in the urban areas were converted to long term prices using the Commerce Department composite construction index. Determination was made of the average annual damages without the project, after the planned land treatment and with the structural measures installed.

Agricultural benefits were based on increased net income. The quantities of land to be benefited in II, III, & IV drainage categories were planimetered from aerial photographs containing the soils information. Through interviews with local personnel of the Soil Conservation Service and Extension Service a comparison of yields and cropping systems was determined under present and future conditions with the project installed.

SUMMARY OF AGRICULTURE BENEFITS

New Sharon Branch - Bridegroom Run - Hancock Creek

LAND USE	WITHOUT PROJECT			WITH PROJECT			Net Increase With Project
	Ac	Yield Per Acre	Net Income	Ac	Flood Free Yield	Net Income	
Potatoes	-	-	-	219	300 cwt	38,076	38,076
Soybeans	269	15-30 bu	5,503	116	35 bu	5,238	265
Corn	87	40-66 bu	2,085	54	80 bu	3,227	1,142
Wheat	61	22-38 bu	287	-	-	-	287
Tomatoes	36	10 T	2,132	89	15 T	14,005	11,873
Alfalfa	35	2 T	1,426	35	4 T	4,010	2,584
M. Hay	69	2.5 T	2,835	44	3 T	3,163	328
TOTAL	557	-	14,268	557	-	67,719	53,451

Associated costs of farm drainage and increased fertilization were deducted from increased net income to determine primary project benefits. The benefits were discounted with a 10 year lag in installation of on-farm drainage measures plus an estimated 10% of the benefitted area not being drained.

The 1960 price base was used for benefits and converted to long term prices as projected in ARS pamphlet "Agricultural Price and Cost Projections," September 1957.

Secondary benefits for the agricultural land were based on 10% of the primary direct benefit plus 10% of the increased associated costs to the producers.

The cost of Bridegroom Run, Hancock Creek, and the upland channels of New Sharon Branch were allocated according to the second alternative procedure described in Section 1132.212 of the Watershed Protection Handbook. Since there were no floodwater damage reduction benefits, this resulted in allocation of 50% of the costs to flood prevention and 50% to drainage. The main channel of New Sharon Branch was allocated according to the first alternative procedure described in Section 1132.211 of the Watershed Protection Handbook. This resulted in allocation of 64.51% of the costs to flood prevention and 35.49% of the cost to drainage.

Fish and wildlife benefits for Sites 4, 5, 6, 18, and 19 were based on data furnished by the N. J. Division of Fish and Game. Their figures of visitor days for fishing and waterfowl hunting were based on similar facilities in comparable areas operated by the Division.

The value of $.50 per visitor day was based on limited development of the sites. Associated costs incidental to obtaining the benefits were deducted from the total benefits.

Recreation benefits for Site 20 were based on a value of $1.50 per visitor day, since this site will be intensively developed for recreational use. Determination of the number of visitor days was made with the assistance of the U. S. Bureau of Outdoor Recreation. Factors considered in making this determination included:

1. Size of reservoir.
2. Surrounding area available.
3. Population and population trends within a 40 mile radius.
4. Existing competitive and complementary developments.
5. Accessibility.
6. Amount and types of planned recreation facilities.
7. Seasonal recreation opportunities.

Incidental recreation benefits for Site 8 were based on $.50 per user day. Number of visitors per day was based on information obtained from local recreational people supervising projects with comparable water recreation facilities.

Appraisals of land, easements and rights-of-way were based on land values obtained from such sources as local real estate agents, tax collectors, assessors, township engineers and planning boards. In areas where rights-of-way involve modification of public utilities, representatives of the respective companies and municipalities were conferred with to determine modification requirements and cost of installation.

Structure Site 8, along with stream channel improvement measures on Pond Run, is evaluated as one unit. The 10 remaining reservoir structures are within a single evaluation unit. Each of the stream channel improvements, New Sharon Branch, Bridegroom Run and Hancock Creek are evaluated individually.

Project evaluation and costs for the reservoirs and Pond Run channel are based on 100 year life expectancy. Project evaluation and costs for stream channel improvement on New Sharon Branch, Bridegroom Run and Hancock Creek were based on a 50 year project life.

The installation costs for each multipurpose reservoir structure were allocated to flood prevention and fish and wildlife or recreation based on the Use of Facilities, as described in the Watershed Protection Handbook, paragraph 1132.1. The specific costs for measures to improve fish and wildlife habitat in Sites 4, 5 and 6 were allocated to fish and wildlife. Similarly, specific costs for measures to improve recreation in Site 20 were allocated to recreation. Flood prevention costs, except for land, easements and rights-of-way and administration of contracts, and 50% of recreation or fish and wildlife costs for the structures, will be paid from Public Law 566 funds.

Secondary benefits stemming from the project were based on 10% of

the primary direct benefits. In addition, secondary benefits induced by the project were also included. These were 10% of the increased associated costs on the joint flood prevention and agricultural water management benefit areas. Secondary benefits result from increased shipping and processing of agricultural products, plus increased use of fertilizer and drainage practices. Dependability of labor and operation of public facilities contribute to secondary benefits.

Indirect benefits were based on 20% of the direct floodwater reduction benefits from Pond Run channel and floodwater retarding structure Site 8. Indirect benefits along the main Assunpink channel were based on 15% of the direct floodwater reduction benefits from the floodwater retarding structures.

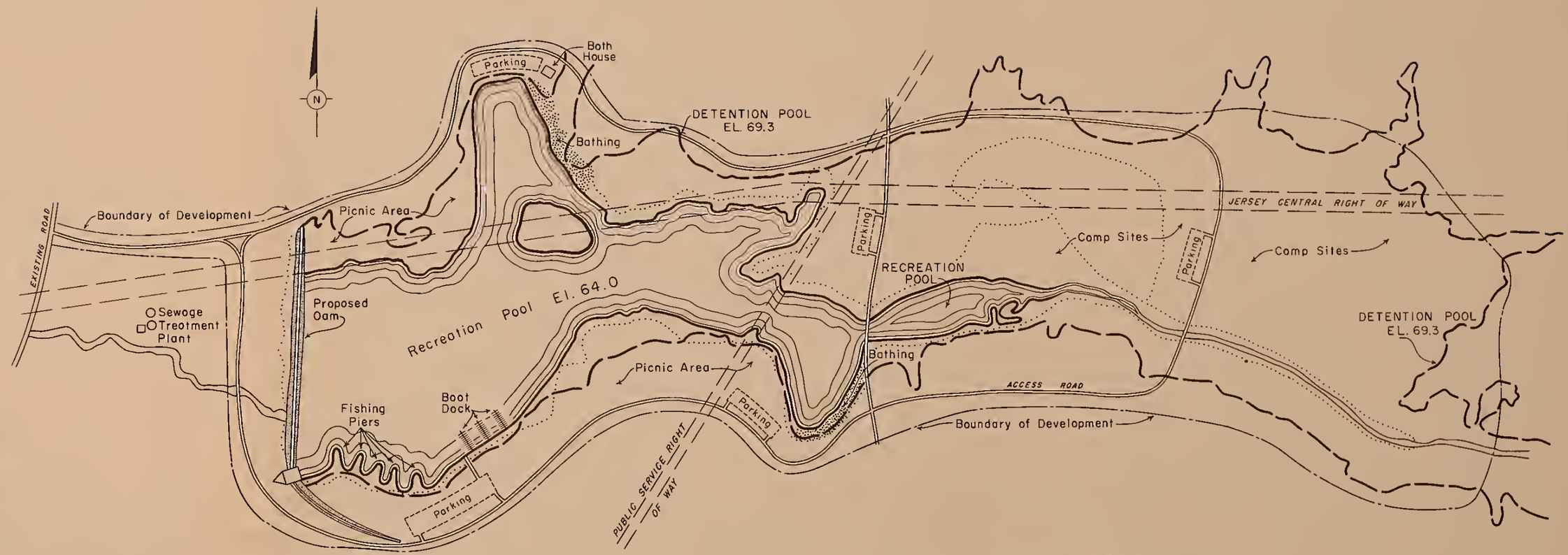


FIGURE 1
RECREATION DEVELOPMENT
SITE 20
ASSUNPINK CREEK WATERSHED

SCHEMATIC VIEW OF STRUCTURE SECTIONS

FIGURE 2. DROP SPILLWAY

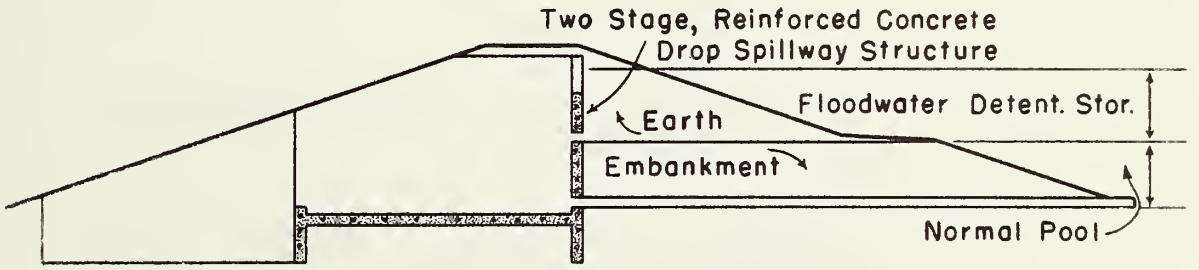
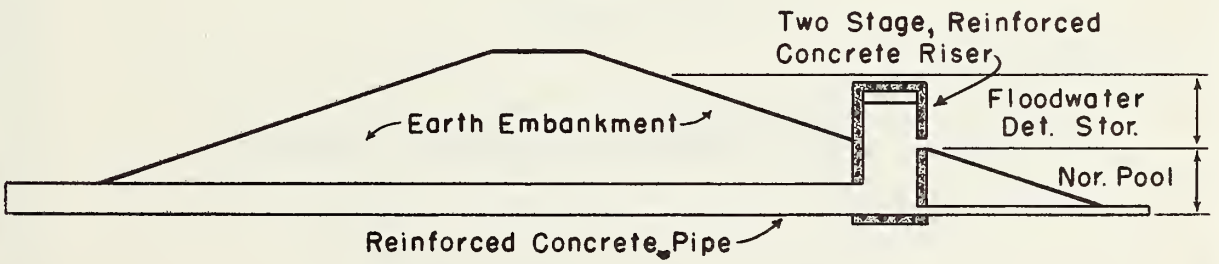


FIGURE 3. PIPE AND RISER



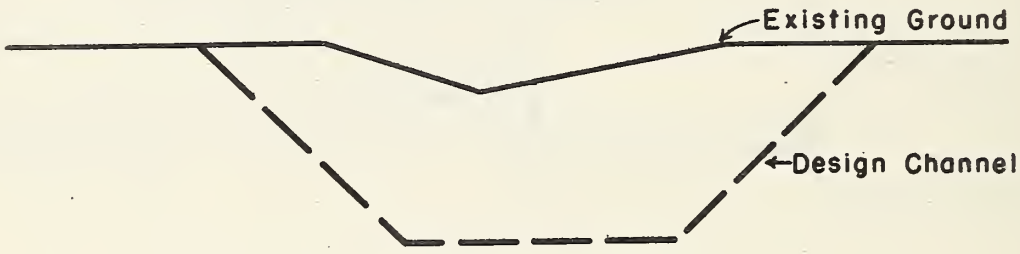
Scale 1" = 20'

FIGURE 4

TYPICAL STREAM CHANNEL CROSS-SECTIONS

NEW SHARON BRANCH

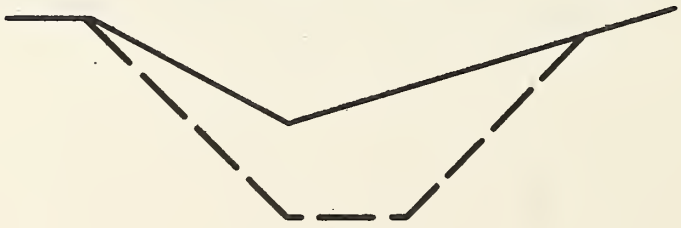
Sta. 84+00



Sta. 146+20

Sta. 162+20

LATERAL #4 - NEW SHARON BRANCH



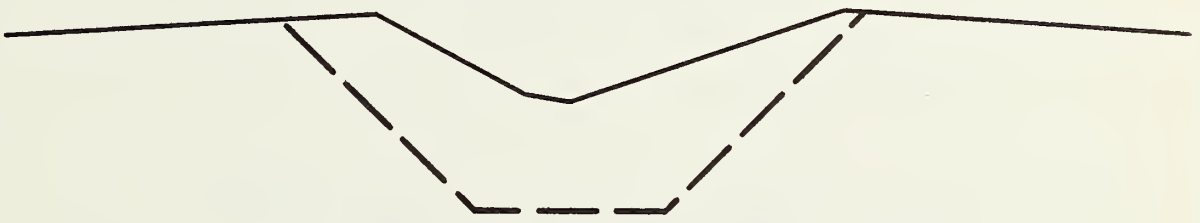
Sta. 24+00

Scale 1" = 5'

FIGURE 5

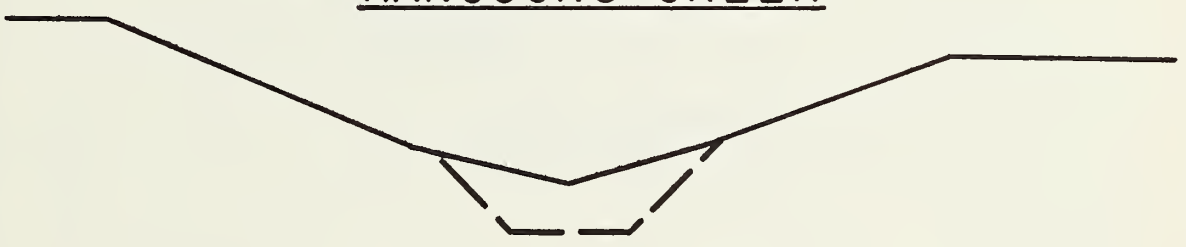
TYPICAL STREAM CHANNEL CROSS-SECTIONS

BRIDEGROOM RUN

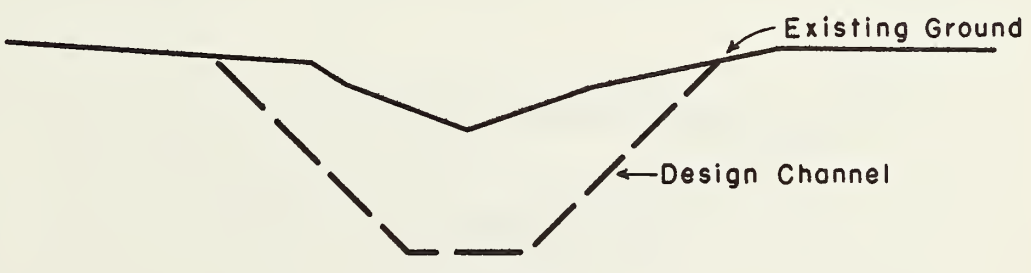


Sta. 95+81

HANCOCK'S CREEK



Sta. 15+31



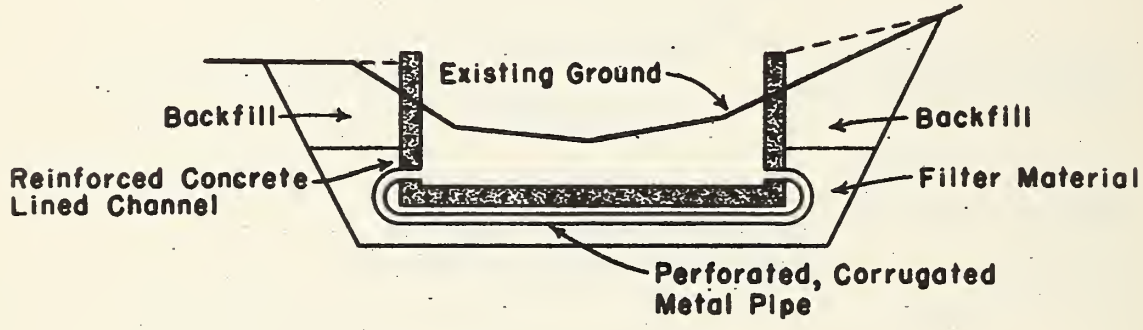
Sta. 31+56

Scale 1" = 5'

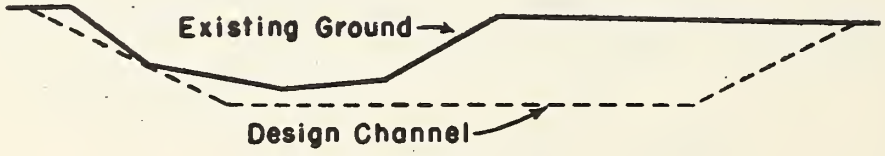
FIGURE 6

TYPICAL STREAM CHANNEL CROSS-SECTIONS

POND RUN



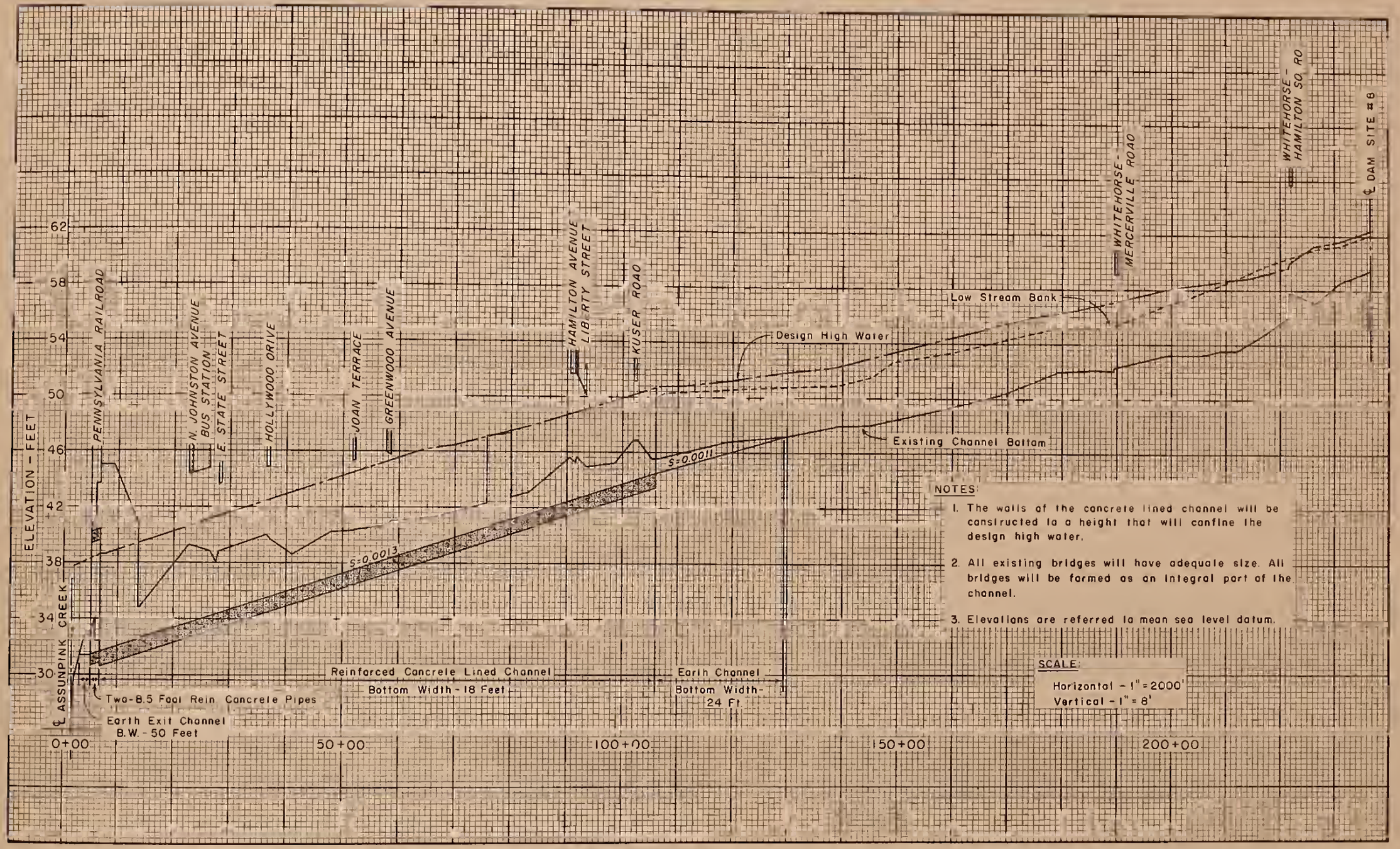
Sta. 40+60



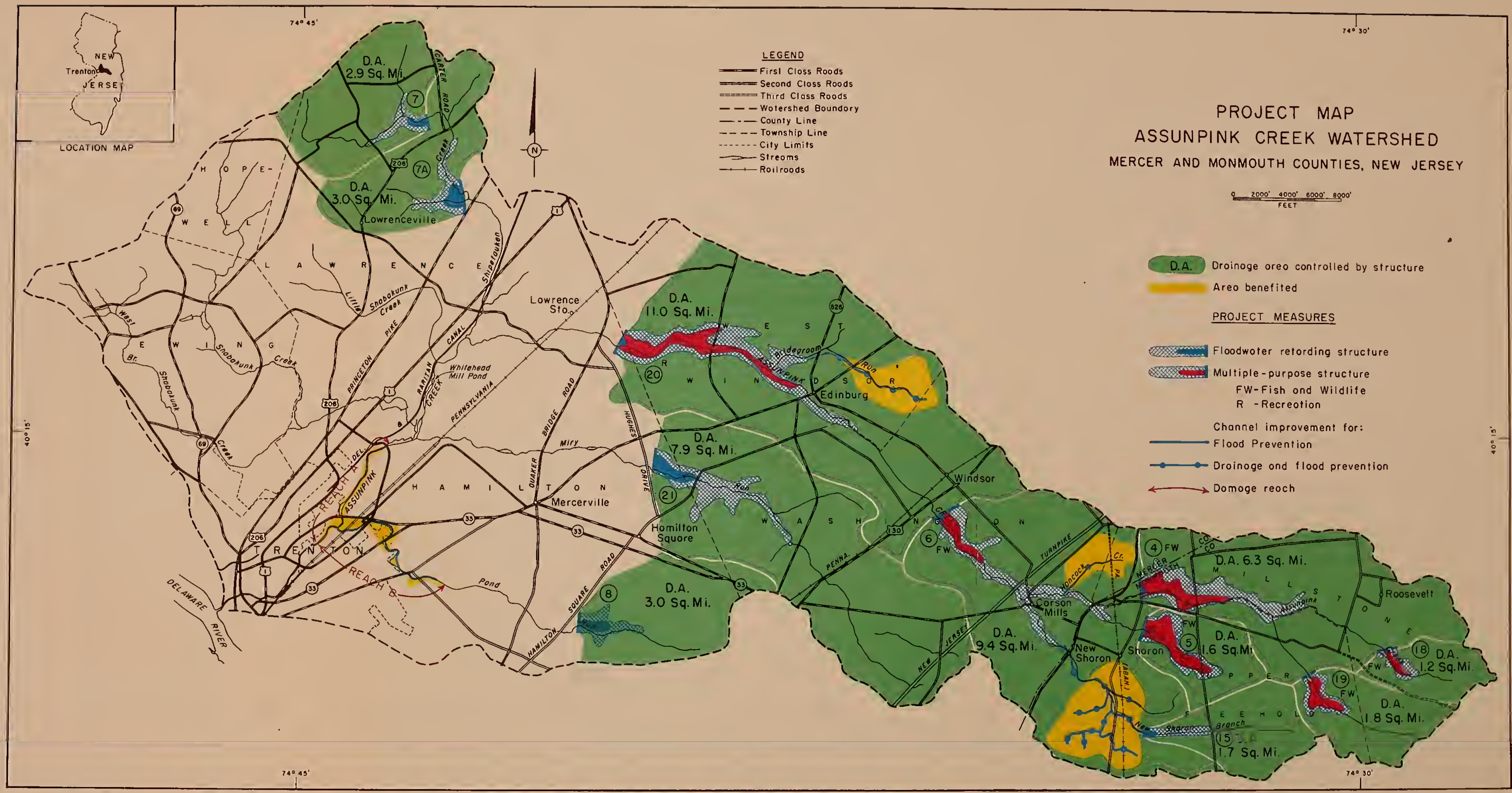
Sta. 120+10

Scale 1" = 10'

FIGURE 7. - POND RUN STREAM CHANNEL PROFILE



Pond Run Flood Plain (Site 8 to Kuser Road) showing the areas still subject to flooding from the 100 and 10 year frequency storms after the project is installed.



PROJECT MAP
ASSUNPINK CREEK WATERSHED
MERCER AND MONMOUTH COUNTIES, NEW JERSEY
LEGEND
First Class Roads
Second Class Roads
Third Class Roads
Watershed Boundary
County Line
Township Line
City Limits
Streams
Railroads
D.A. Drainage area controlled by structure
Area benefited
PROJECT MEASURES
Floodwater retarding structure
Multiple-purpose structure
FW-Fish and Wildlife
R -Recreation
Channel improvement for:
Flood Prevention
Drainage and flood prevention
Damage reach
LOCATION MAP
NEW JERSEY
Trenton
D.A. 2.9 Sq. Mi.
D.A. 3.0 Sq. Mi.
Lawrenceville
D.A. 11.0 Sq. Mi.
D.A. 7.9 Sq. Mi.
D.A. 3.0 Sq. Mi.
D.A. 9.4 Sq. Mi.
D.A. 6.3 Sq. Mi.
D.A. 1.6 Sq. Mi.
D.A. 1.2 Sq. Mi.
D.A. 1.8 Sq. Mi.
D.A. 1.7 Sq. Mi.
Lawrence Sta.
Edinburg
Windsor
Mercerville
Hamilton Square
Corson Mills
New Sharon
Sharon
Roosevelt
TRENTON
HOPEWELL
LAWRENCE
EWING
HAMILTON
WEST WINDSOR
WASHINGTON
MILLSTONE
UPPER FREEHOLD
REACH A
REACH B
DELAWARE RIVER